THE ESTABLISHMENT OF HISTOLOGY IN THE CURRICULUM OF THE LONDON MEDICAL SCHOOLS: 1826 - 1886.

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ABSTRACT

This thesis sets out the way in which histology became established in the curriculum of the London medical schools between 1826 and 1886. The text provides a very large number of references to original material, some of it previously unreported.

Histology had its origins in continental Europe in the early years of the nineteenth century, in the work of Bichat. The introductory chapter examines how this was translated both as to language and as to practical experience into England. The role of the developing achromatic microscope is also briefly considered.

The changes in medical education in London which fostered the teaching of 'general anatomy' (histology) are then described from primary sources in some detail, and with extensive necessary quotation. The establishment and development of medical departments and the appointment of key teachers was pivotal and is fully investigated, while the role of the medical press in infuencing change is also assessed. The teaching programme of each college is explored using evidence from surviving lecture notes, texts, diaries, calendars and correspondence. The changing requirements for qualification, and their influence on the examination system, which accompanied the growth of histological teaching, are discussed.

In order to trace the incorporation of the cell theory, the growing understanding of the tissue concept, and the relationship between structure and function, into the teaching of histology, a case study of the histology of the liver has been pursued throughout the thesis. The development of knowledge of the histology of the liver has been traced through the large number of textbooks which were produced to support courses in histology.

Throughout the period, steadily increasing specialisms from virtually all other aspects of the curriculum vied for inclusion, with more and more time being given over to new and diverse subjects. In this competition for time and resources histology eventually found a permanent place. The events leading to a formal requirement to teach practical histology are examined, and key people in these changes are identified. The effects of the legislation on texts, equipment, specialist accommodation, teaching skills, and time are assessed.

CONTENTS

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Patricia Bracegirdle

LIST OF ILLUSTRATIONS

INTRODUCTION - THE TISSUE CONCEPT TRANSLATED.

The establishment of histology in the curriculum of the London medical schools in the nineteenth century had its roots in continental Europe. The translation of early tissue concepts into clearly taught courses of study involved not only refinement and dissemination over many decades, but also the development of instruments by means of which the nature of the tissues could be more clearly established. The work of individual men, both in research and teaching, the associations they made, the circumstances in which they worked, and the social, political and professional attitudes prevailing at the time, slowly resulted in the codification of histology into the medical curriculum in England.

Bichat's *Anatomie Générale*

Credit for the inception of the science of histology has been given to Bichat . . .

> During the year 1801, histology became indirectly indebted to the genius of a member of the medical profession, who, although not himself a great discoverer, yet so well understood how to arrange existing materials, and to bring them into harmony and close relationship with physiology and medicine, that it [sic] soon acquired for itself an independent existence. The future of histology was secured the moment Bichat gave to the world his admirable work, 'Anatomie Générale'.

Such was the accolade given in London by Jabez Hogg, Esq., President of The Medical Microscopical Society, in his Introductory Address to the first ordinary meeting of the society in January 1872[1].

Similarly, Pickstone[2], writing more than a century later than Hogg, claims that

> there can be little doubt that Bichat's most impressive contribution, for his contemporaries and for later generations, was the notion that the human body and other living bodies could be analysed into elements, the tissues, which were variously combined into organs . . .

The life and work of Marie-François-Xavier Bichat (1771-1802) have been described in detail by Haigh[3]. She has pointed out how, as a student of Desault, Bichat's own professional contacts were fostered, and that these helped to formulate his own notions of anatomy and physiology.

Shryock has discussed the emergence of modern medicine in France in the nineteenth century, in the context of the intellectual environment of the time, with its emphasis on careful observation of phenomena and on the avoidance of speculative hypothesis[4]. He has cited in particular the influence of the physicians Cabanis and Pinel, whose analysis of clinical data was made by tracing them back to their source in organs. Bichat, Shryock observed, was the product of this environment[5]. Ackerknecht, too, pointed to Pinel's claim to have inspired Bichat in the field of disease of the mucous and serous membranes.[6]

There is ample evidence that Bichat performed a large number of post-mortem dissections and was a tireless worker, which counters Hogg's rather cynical suggestion that his work was merely synthetic and contained nothing original. A notice of Bichat's life, read shortly after his death to the 'Société Médicale d'Émulation', a group representing the opinions of the new medicine emerging at that time, gave a contemporary view of his labours, albeit couched in the fulsome terms of an obituary . . .

> the essay on the membranes . . . was but the summary of a large work, which he soon published on the same subject. He did not attempt this till after multiplying on himself experiments often dangerous, and after devoting himself to an attentive observance of morbid phenomena.[7]

It was Bichat's access to anatomical material that enabled him to pursue both his teaching and experimental work on anatomy and physiology. His four volume work *Anatomie Générale*[8] was based upon careful observation and analysis of the bodies which he dissected.

Haigh has described the *Anatomie Générale* as a classic example of a deliberate application of the method of analysis: "Bichat decomposed the complex body parts and organs so as to isolate and study the simple tissues composing them"[9]. Jacyna, on the other hand, has stated that it was Bichat's concern "to offer a topographical or natural historical account of tissues to which was subjoined an analysis of their vital properties"[10]. Foucault, in his elegant discussion of Bichat's work, declared that "Bichat is strictly an analyst: the reduction of organic *volume* to tissular space is probably, of all the applications of analysis, the nearest to the mathematical model yet devised."[11] Albury, too, described Bichat's research methodology, contrasting it with that of Magendie. Bichat, he said, used the term "observation" to designate experience in general, and he assigned priority to simple observation as a means of acquiring physiological data[12]. Only after first observing the normal subject, did he move on to pathological observation followed by experimentation[13].

Bichat's analysis led to his division of anatomical matter into twenty one basic elements, which he called tissues, and to which he believed the vital forces of sensibility and irritability belonged.

> These tissues are 1st. The cellular membrane. 2dly. The nerves of animal life. 3dly. The nerves of organic life. 4thly. The arteries. 5thly. The veins. 6thly. The exhalents. 7thly. Absorbents and glands. 8thly. The bones. 9thly. The medulla. 10thly. Cartilage. 11th. Muscular fibre. 12th. Fibrocartilaginous tissue. 13th .Muscles of organic life. 14th. Those of animal life. 15th. The mucous membrane. 16th The serous. 17th. The synovial. 18th. The glands. 19th. The dermis. 20th. The epidermis. 21st. The cutis. Such are the real organised elements of our frame. Whatever be the nature of those parts which are blended together, theirs remain uniformly the same; as in chemistry, simple substances do not vary, however the compounds they unite to may differ.[14]

The structure, distribution, properties and particular functions of each of the tissues he identified was described. He located vital properties in the solid organs only, being uncertain of the role of fluids . . .

> Although vital properties have their especial abode in solids, we must not consider the fluids are purely inert . . . to say what that vitality of fluids is, is evidently impossible; but its existence nevertheless is not less real[15].

Ackerknecht has described Bichat as "a determined solidist" and his splitting up of organs into tissues as his application of the sensualists' idea of analysis. He went on to say "it netted Bichat the title 'father of histology' ", and later qualified that by adding that Bichat's histology was so tied up with vitalism that it became usable only after elimination of these latter elements.[16] For Bichat, though, vitalism and tissue anatomy were inextricably bound up. He treated the tissues as living elements, the smallest units into which one could subdivide the organism, further breakdown being brought about by putrefaction.

Bichat used only a simple lens as an aid to his observation of tissues, even though compound microscopes were readily available. In *Traité des Membranes,* he described the microscope as

> a species of agents from which physiology and anatomy, do not seem to me, besides, ever to have derived any great assistance, because when we view an object obscurely, everyone sees in his own way, and accordingly as he is affected. The observation of the vital properties ought then above every thing to guide us . . . [17]

It is possible, with hindsight, to judge Bichat's distrust of the compound microscope as curious, and even to speculate on what alternative scheme he might have put forward had he used one. As it is, though, he can be seen as exercising proper caution in his scientific enquiries.

Most importantly, though, he was able to investigate the presence of specific tissues in many bodies of various ages, as well as in healthy and diseased subjects. In the year 1801-1802 he was said to have performed six hundred autopsies. As Maulitz has pointed out, the autopsy table rather than the microscope, was the primary tool.[18]

Bichat included no illustrations in his works, relying on his detailed descriptions of anatomical structure to inform his readers. One must suppose that he felt that his concept of the tissues, being the location of the vital properties, could not be rendered in any meaningful way in two dimensions.

In his *Anatomie Générale,* he extended his tissue concept to disease and to morbid anatomy, maintaining that if each tissue was unique in health, it must be so in disease also. . .

> Since diseases are nothing else but alterations of vital properties, and tissues differ so widely in respect of these properties, they must clearly differ also in the diseases incidental to them . . . Since every organised tissue has every where a general arrangement, and, whatever its situation may be, retains the same structure and properties, &c., its diseases must unquestionably be everywhere the same[19].

Bichat then went on to exhort his readers, and particularly the physicians among them, to study the dead body . . . "Let us study the dead body, and the obscurity, which observation only cannot dispel, will quickly disappear in the evidence it affords." Ackerknecht has suggested that although this was by no means the central theme of the book, it actually became the centre of Bichat's legacy[20]. 'Open up a few corpses' was also a theme taken up and expounded by Foucauld[21].

British students in Paris.

It is usually to Robert Knox [1793-1862][22], that the credit of introducing to the British student the subject of 'General Anatomy', has been given. He had studied medicine in Paris, and Lonsdale[23], a pupil and later a colleague of Knox, writing in 1870, observed that the French indoctrination had been a powerful influence upon Knox. Knox's stay in Paris was not, however, his first introduction to Bichat. In his biographical study of Bichat[24], Knox recorded that . . ."Napoleon had sealed continental Europe against England, and French works were rare. Still, Bichat's work had crept into Britain. I saw them in 1811-12 . . ."

Knox's studies in Paris were typical of those undertaken by a large number of British medical students in the 1820s, following the end of hostilities between England and France. Maulitz[25] has described in detail the circumstances of this exodus to France. In brief, two factors were attractive to the British students: firstly, the regulation of the market in cadavers in France, where the legality of obtaining bodies for dissection meant that not only were they readily available, but at a modest cost; and secondly, the integration of anatomy, pathology and bedside medicine, with the expectation that students would follow their professors, be they clinicians, physicians or surgeons, from hospital ward to lecture theatre and then to the dissecting theatre, in an attempt to correlate before-death external symptoms with post-mortem pathological appearances of tissues and organs, namely, the routine of the Paris clinic.

The Scots were early to seize this opportunity and Knox found himself with other Scots students. One of these was William Sharpey [1802-1880], nine years younger than Knox, and, in 1821, a young postgraduate student. Another was Thomas Hodgkin [1798-1866], who had been a student at Guy's Hospital in London, and, after his studies in Paris was to return to Edinburgh to graduate MD in the same year as Sharpey. He was invited by Knox to join him in dissection and the study of pathological anatomy in a private dissecting room that he had rented at the Hôpital de la Pitié[26]. It is clear that Sharpey was also part of this group, since Hodgkin referred to it when supporting

Sharpey in his application to The University of London in 1836 [see p. 84 below]. . .

> **We were in Paris together during a considerable part of the year 1821-2, and as we dissected at the same table, I had ample opportunity of knowing that he was even then an excellent practical anatomist , and remarkably well acquainted with British and Foreign anatomical writers.[27]**

The practice of forming small working groups was not unusual. The establishment of one such course by James Richard Bennett [d. 1831], in 1822-23, and the fracas which followed, [see below p. 33], led eventually to a change of the regulations in France in 1834, which prohibited dissection in hospitals and related institutions. By then, however, many British students had returned home and taken with them their newly acquired skills, knowledge and attitudes.

Translations into English

Bichat's *Traité des membranes*[28] had been translated into English and published in America in 1813[29], but it was not until 1822 that the first relatively detailed account of his tissue concept was published in Britain. This was in the form of a review in the *Edinburgh Medical and Surgical Journal*[30] of P A Béclard's *Additions à l'Anatomie Générale de Xavier Bichat*[31].

Béclard had published his volume whilst Professor of Anatomy in Paris, and it was seen by the reviewer, probably Robert Knox, as offering a commentary on the parts of Bichat's system which "imperfect observation, premature inference, or the natural and progressive acquisitions of science have rendered defective or fallacious". The analysis then set out to exhibit "a brief but correct view of the present state of general anatomy". The *Additions* were not translated, and Coffyn's work, published in London and Edinburgh in 1824[32] was the first full translation of *Anatomie Générale* into English.

The work of Béclard was not, though, the only text to be reviewed at that time. Three years earlier, again in the *Edinburgh Medical and Surgical Journal*[33], Magendie's *Precis Elementaire de Physiologie*[34], which had been published in 1816-17, was discussed. Magendie had classified the tissues from a physiological, rather than an anatomical, point of view, and had contrasted his arrangement with that of Bichat.

Béclard, meanwhile, had published his own text *Elémens d'anatomie générale* in 1823[35], translated into English by Knox in 1830 for the use of his students[36].

Lonsdale[37] has given a good indication of the introduction of French texts and of the teaching methods which Knox adopted on his return to Edinburgh.

Grainger's *Elements of general anatomy*[38], published in 1829, is credited with being the first work on the anatomy of tissues to appear in the English form, although Lonsdale declared this to be a scarcely modified version of Béclard's text, with Richerand as its physiological authority. Lonsdale saw it as odd that Knox should have chosen 1829 as the year to translate Béclard's 'General Anatomy'[39], the same year also in which Storer translated Bayle and Hollard's 'Manual of General Anatomy'[40], from the French. Indeed, Storer, in his preface, says that

> General Anatomy has hitherto been much neglected . . . to this period no works have been published exclusively on this subject in English, except Bichat's writings, which have been translated from the French: these, however valuable, are from their size, inaccessible to many readers. GENERAL ANATOMY possesses the strongest claims on our attention, as being the only solid basis on which *Practical Anatomy* can be properly studied; by affording us a knowledge of the primitive tissues of which the body is composed . . . the present volume is calculated to fill a chasm which appears to exist[41].

Bayle and Hollard quoted the classification of the tissues by previous authorities, including Bichat and Meckel, but adopted a different arrangement designed to explain "their progressive complication of structure"[42]. Each group of tissues was described under the headings: general appearance; structure; variations with age; physical and chemical properties; vital properties; functions; and morbid anatomy. Their latest authorities quoted for the fine structure of the tissues were Prévost and Dumas and Dutrochet.

Lonsdale expressed surprise that the views of Mayer in his *Histologie*[43], pointing to a newer version of structure, had not attracted Knox. C Mayer, Professor of Anatomy and Physiology in Bonn, had published a pamphlet in 1819, in which he described the work of Bichat, listing his twenty one tissues, and citing the work of Meckel and Hempel, with Meckel's division of the tissues into just ten groups. Mayer's is the first use of the term 'histology'. In his work, Mayer explained the origin of the word from the Greek 'ἱότος', meaning web or tissue, and presented a new division of eight groups: epithelial, cellular, fibrous, cartilaginous, bony, glandular, muscular and nervous, each being further sub-divided. The pamphlet was translated into French but not into English.

Knox gave his reasons for translating Béclard . . ."To meet the wants of my own class . . . what I deemed to be the best of the numerous very excellent manuals of General Anatomy . . ."[44]

The author himself acknowledged that his book was a summary of his course on anatomy delivered over the previous ten years and said that it was intended solely for the student, presenting him with "a condensed view of the many researches made into human organisation for a period of more than twenty ages".[45] He naturally quoted Bichat and pointed out that both Bichat and Mayer had identified three types of tissue, the cellular, the vascular and the nervous, as being 'elementary' or generators of others.[46]

Microscopical appearances

Although Bichat distrusted the microscope as an investigative tool, other workers of the period did not. Béclard reported the observations of the anatomy of the tissues by both French and English microscopists.

> The microscopical observations of M. Bauer and Sir E Home, published with very beautiful figures, represent the muscular fibre as identical with the particles of red blood deprived of their colouring matter, and of which the central globules are connected into filaments. MM. Prévost and Dumas have constantly obtained the same result, whatever animal was examined, and of whatever form or size its globules were. My own observations perfectly agree with theirs[47].

This concept, that the tissues were ultimately made up of minute globules, was clearly expressed in 1823, in his MD thesis, by Milne-Edwards[48], a friend of Hodgkin during his student days in Paris. Henri Milne-Edwards [1800-1885] had examined the findings of other workers in the field, including Fontana, Bauer, Home, the brothers Wenzel, Prévost and Dumas; indeed it was Dumas who had first given him the idea for his work[49]. Using their microscopical observations, together with his own findings, and illustrating his thesis with a series of engravings showing strings of globules from a range of tissues, he concluded that the structure of tissues in all animals was identical, being made up of globules of 1/300th of a millimetre in diameter[50].

Pickstone[51] has examined the patterns of thought which underlay such investigations and conclusions. He suggested that the explanation of the emergence of the globule theory in the early nineteenth century rests, not so much on the development of the microscope, but on the ease with which globules fitted into the pattern of contemporary physiological thought, with its emphasis on the formation of tissues from fluids. The most important characteristic, in this connection, he argued, was not the increased possibility of seeing globules, but the increased incentive to look for them. Home, Prévost and Dumas, and Milne-Edwards, he pointed out, saw coagulation of albumen, and other organic materials, into globules as the model of tissue formation, while Meckel, working in Germany, had come to the conclusion that tissues were primarily composed of globules in a homogeneous matrix.

Pickstone[52] recorded that Milne-Edwards's view became accepted in the context of general anatomy, while that of Meckel was incorporated into Béclard's works.

Johannes Friedrich Meckel [1781-1833], Professor of Anatomy at the University of Halle, rejected pure speculation and stressed instead the acquisition of empirical data from which useful conclusions could be derived[53]. He had studied in France, and it was into French that his five volume work[54] was translated in 1825. He addressed general, descriptive and pathological anatomy. The translation included a footnote giving details of Milne-Edwards's work on globules, together with an account of the way in which workers from Bichat to that date, including Béclard, had arranged the tissues[55]. The French translation was further translated into the English language by Doane[56], published in America in 1832, and in England in 1837, when the general anatomy section was published as a separate volume[57].

The microscope which Milne-Edwards used in his work was an Adams instrument lent to him by Dumas[58]. This "excellent" instrument, he said, had enabled him to make accurate observations. We now know that high-power images seen with such an instrument were subject to considerable spherical abberation. Further, the unsophisticated methods used in preparing tissues for examination at that time, together with Milne-Edwards's relative lack of experience as a microscopist, suggest that, at best, a poor image would have been obtained. Bracegirdle[59] has made fresh tissue preparations using techniques of the early nineteenth century, and examined them with microscopes in use at that time. He has demonstrated quite clearly the images of globules likely to have been seen by Milne-Edwards and his contemporaries.

Milne-Edwards and Hodgkin, having become friends in Paris in 1821, were well aware of each other's interests and researches. In a letter[60] dated 26 March, 1827, Milne-Edwards wrote "I shall . . . forward to you the memoir . . . which contains the continuation of my microscopical observations on the elementary structure of organic tissues".

Hodgkin and Lister

Hodgkin had returned from Paris in 1822, graduated MD from Edinburgh in 1823, and, after a further period in Paris, returned to Guy's Hospital in London. Here he was at first an unpaid clerk, and then, in 1826, he was appointed to the salaried post of Inspector of the Dead and Curator of the Museum of Morbid Anatomy[61].

In London, Hodgkin's circle of acquaintances included not only his professional colleagues, but also those with whom he associated in his active membership of the Society of Friends. In this latter group, the Hodgkin family and the Lister family were close friends.

Joseph Jackson Lister [1786-1869], had, from childhood, been interested in optics[62]. In 1826, he designed a powerful achromatic compound microscope with lenses virtually free from spherical abberation. Bracegirdle has given a detailed account[63] of the construction and of the performance of this instrument, which is now in the Wellcome Collection at The Science Museum in London.

J J Lister's son, Joseph, in his obituary[64] of his father, gave details of his work but, remarkably, in view of his own profession, made no mention of the key paper[65] prepared by Lister and Hodgkin on their immediate application of this microscope to the study of animal tissues. This important paper, published in August 1827, marked a turning point in the science of histology, because, for the first time, an undistorted image of the structure of the tissues was described.

The paper described blood . . .

> circular flattened transparent cakes, which, when seen singly appear to be nearly or quite colourless. Their edges are rounded, and being the thickest part, occasion a depression in the middle, which exists on both surfaces . . . [66]

and contrasted their findings with those of other workers . . .

> We were also desirous of not hastily or rashly denying the existence of those colourless globules which have been strongly insisted on by Sir Everard Home and Bauer, and by Prévost and Dumas, and which have been regarded not merely by themselves, but by other distinguished and intelligent physiologists, as constituting by their varied combination the different organic tissues . . . we have in vain looked for these globules.[67]

Hodgkin's description of muscle once again denied the globular structure . . "Although no trace of globular structure can be detected, innumerable very minute, but clear and fine, parallel lines or striæ may be distinctly perceived transversely marking the fibrillæ"[68], and in his description of nerves . . ."We have looked in vain for globules, as well as for any trace of medullary matter, which has been somewhat gratuitously supposed to be inclosed in nerves".[69]

Milne-Edwards certainly took no offence, since in December of the same year he wrote to Hodgkin . . .

> Early next year I expect to be in Paris and think one of the first things I shall do will be to repeat your interesting researches on blood, animal tissues, etc.. Dumas, Broughton and myself have in our possession one of Amici's microscopes and I hope we shall be able to settle to our mutual satisfaction all the disputed points respecting that important subject.[70]

In their paper, Lister and Hodgkin acknowledged the quality of the Amici instrument, saying that they had found it impossible to decide the question of superiority between the Lister and the Amici microscope. Amici, Professor of Mathematics at Modena, had an instrument with him when he had visited London and had allowed Lister to test it against his own[71]. Hodgkin and Amici were evidently on good terms, as letters were exchanged between them couched in warm terms[72].

This was not the first reference to the value of the Amici instrument. As a footnote to a review of Sir Everard Home's Croonian Lecture of 1818, the editor of the *Edinburgh Medical and Surgical Journal*[73] expressed indebtedness to the Archduke Maximillian of Austria, for his report of Amici's description of the blood globule, as observed with his own instrument. He had included a diagram to show the shape of the blood corpuscle in his description, but Hodgkin and Lister did not illustrate their paper in 1827, nor yet an updated version which appeared as an annexe to a pamphlet translated by Hodgkin in 1832[74].

Minute anatomy in print

One of the earliest English texts to give a detailed commentary on the minute anatomy of the tissues was that of John Bostock [1773-1846][75]. He wrote many original papers for the *Edinburgh Medical and Surgical Journal*, but his most successful book was his three volume *Elementary System of Physiology*[76], which enjoyed wide popularity and reached its fourth edition in 1844.

In a note added at the end of the first volume, published in 1824, he acknowledged Amici's observations on the globules of the blood, adding,

> it may afford curious matter for speculation to those who place much confidence in microscopical observations; it is, however, proper to observe that the statement does come directly from the author himself.[77]

In his third volume, which included appendices to take account of new findings since his first volume was published, he recorded the work of Milne-Edwards and of Dutrochet, of whose findings he notes "they are however called into question by Dr Hodgkin, who has been employing the microscope in the examination of various animal substances"[78]. Having quoted from Hodgkin's paper, Bostock declared that

> it will appear, from the evidence that is now before us, it becomes a question altogether of personal authority. It does not depend upon the respective goodness of

the instruments employed, because the different observers describe what they saw as being perfectly distinct and obvious, and not presenting a confused or uncertain aspect, which arises in a deficiency in the power of the lens. We are compelled to suppose that all the observers, excepting one, has fallen into some error, either depending upon an optical deception, or resulting from some unconscious and involuntary bias of the mind towards a previous hypothesis.[79]

In the following year, 1828, S D Broughton, with whom both Hodgkin and Milne-Edwards were acquainted, wrote a long article in the *London Medical Gazette*[80] on the 'Elementary Nature of Animal Structures'. Broughton repeated in detail Milne-Edwards's globule theory, and referred to the major workers on the structure of the tissues. Towards the end of his paper, having compared the conclusions of Milne-Edwards and Dutrochet, he declared that the central globules,

on which Dr. M Edwards sets so much value, as so very important a consideration in the animal economy and the basis of primitive organisation, these Dr Hodgkin entirely disregards . . . at one fell swoop the labours of his predecessors and contemporaries alike are destroyed[81].

Broughton quoted Bostock, who was fairly clearly his source, and claimed, as Bostock had done for Hodgkin, personal acquaintance with Milne-Edwards. He went further than Bostock though, in his final analysis of where the truth may rest. Having acknowledged that if Hodgkin was correct, then the errors of other workers must be due either to their instruments or to the influence of prejudice, he went on . . .

I am inclined to think, that the contrarary conclusions of a single individual, though highly deserving of attention, are . . . to be regarded with equal suspicion; more especially in Dr Hodgkin's case, when the instrument adopted is one of such great magnifying powers, through which nature may possibly be viewed in distorted and aggravated forms - caricatured, indeed, rather than truly and faithfully represented to the eye.[82]

More than a quarter of a century after Bichat's death, then, both distrust of the instrument and doubts about the objectivity of the observers were still much in evidence. For some too, the debate about the structure of the tissues had become tiresome. Knox, in the preface of his translation of Cloquet's *System of Human Anatomy*[83], waspishly stated that . . .

His omission of what is called general anatomy, with all its absurd theories, its tiresome diffuseness, its verbosity and unprofitable minuteness, ought to be deemed by the student an advantage and a recommendation . . .

This remark earned Knox the censure of the editor of *The Lancet*[84], who contrasted Knox's views with those of Jones Quain, whose *Elements of Anatomy* was also first published in 1828. Quain was quoted as saying that a knowledge of the structure and composition of each organ is necessary to the understanding of function, leading to the investigation of lesions induced by disease, establishment of a correct diagnosis and a rational plan of treatment; a view almost identical to that expressed by Bichat in the last year of his life.

It remained, however, for Grainger to provide the first English text on general anatomy. Richard Dugard Grainger [1801-1865] published his *Elements of General Anatomy*[85], in 1829, and dedicated it to his students at the Webb Street School. He observed that there was no text exclusively devoted to the subject and acknowledged the difficulty, for students, in obtaining "an acquaintance with this important branch of anatomical knowledge"[86]. The text, he admitted, was a compilation, chiefly of the works of Bichat, Béclard and Meckel, together with material published in Britain. He reminded his readers that it was impossible to appreciate the changes produced by disease in the various parts of the body, without being previously acquainted with their natural and healthy structure.

It should not be imagined that the compound microscope, even in its uncorrected form, was readily available to teachers such as Grainger. Grainger had had to borrow a microscope from a colleague, Cooper, in order to verify, where possible, the observations of other workers. He was also afforded the opportunity of using Lister's instrument. Grainger quoted from Hodgkin's paper and agreed with the conclusions . . . "the experiments were made with the assistance of a powerful and perfect microscope . . . my observation entirely confirmed that of Dr Hodgkin . . . "[87].

Grainger's text is eminently readable. Having divided the tissues into eleven categories, which, he stated, seemed to him to be the most perfect arrangement[88], he went on to give details of each group, under the headings; quantity; location; organisation, divided into observations with the naked eye and with the microscope; chemical composition and properties and functions.

Grainger, too, awarded an accolade to Bichat, in saying that the

Anatomie Générale had been received throughout Europe as the very foundation of the branch of knowledge upon which it treated.

The diffusion of information and ideas throughout Europe was, of course, vital to the development of the tissue concept. Bostock, in his *History of Medicine*[89], wrote that . . .

> a circumstance which has materially contributed to the improvement of the knowledge of practical medicine is the publication of periodical works, whether in the form of journals or of transactions of societies . . . [90].

Improvements in printing and communications during the first quarter of the nineteenth century had enabled scientific ideas to diffuse more rapidly to more people than ever before. With the publication in Britain, not only of translations and texts, but also of reviews and editorial comment in the medical press, general anatomy can be said to have become established in the thinking of investigators, and was becoming known to teachers. To most students though, and to medical practitioners, it remained unknown territory.

Bostock further remarked that

> the cause and the consequence of the progress of our art, is the improved state of medical schools of all descriptions, both those allocated to universities or to public hospitals, and those conducted by private individuals.[91]

In London, the introduction and acceptance of general anatomy must now be placed in the context of this improvement in medical education, where key practitioners in the science were also important agents of change.

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CHAPTER ONE.
A DECADE OF CHANGE: 1826-1836.

In the early decades of the nineteenth century, London offered a broad medical curriculum, and large numbers of students came to seek training on the surgical wards of the large hospitals and to supplement their hospital experience with attendance at lectures, both in the hospitals and in the private anatomy schools which flourished in the metropolis.[1] Both Lawrence[2] and Ellis[3] have pointed out that the Apothecaries' Act of 1815 established, through the power it gave the examiners to establish criteria, specific educational standards. While instituting reform, this set a pattern of basing a curriculum on acceptable experience, with standards which many pupils had chosen voluntarily.

In England the training and entry qualifications required by the three licensing bodies, The Royal College of Physicians, The Royal College of Surgeons and The Society of Apothecaries, remained separate. The barriers which had been broken down in France, enabling both physicians and surgeons to consider the significance of the newly emerging disciplines of general and pathological anatomy, and their application to physical examination and diagnosis, remained intact.

Singer and Holloway, in their assessment of the role of the licensing bodies on medical education in the early nineteenth century, have identified the chief function of the medical schools of London from 1815-1855, as being the training of young men to be good doctors with status given by the Licentiateship of The Society of Apothecaries or the Membership of the Royal College of Surgeons, or both.[4] It was towards these qualifications that students worked in both hospital and private medical schools in London.

The history of the origins of, and the competition between, the hospital surgeons and the private anatomy schools has already been well told.[5] Impersonal rules replaced the examiners' personal knowledge of teachers and institutions, and the wide diversity of independent lecturers, small schools and private theatres of anatomy gradually disappeared, as what Lawrence has termed the "open market" in medical education slowly closed.[6]

The courses offered

The range of courses offered to the London student in the Medical Session 1826-1827 was published in *The Lancet*.[7] Four hospital schools, at St Bartholomew's, St Thomas's, Guy's and The London, were listed as offering lectures, together with seven Theatres of Anatomy, at Webb Street, Blenheim Street, Dean Street, Great Windmill Street, Little Windmill Street, Chapel Street, and Berwick Street, and a number of men offered individual private tuition. It should not be assumed that the work of the hospital schools and that of the private anatomy schools were incompatible. From the point of view of the student, in particular, the lectures and demonstrations offered at the anatomy schools were a necessary supplement to the practical experience of the hospital schools. For the teachers, with their own private practices, an honorary clinical appointment at a hospital was valuable, not only for the scientific and clinical experience it provided, but also for the significant remuneration in fees from apprentices. The opportunity of lecturing or demonstrating in a private anatomy school was a means of supplementing income and of becoming well known in professional circles. Only the man with substantial private means could afford the luxury of research, unhindered by a busy practice.

This chapter examines the introduction of general and pathological anatomy into the curriculum in London at a time of great change in the institutions offering medical education, and the role of the teachers, in both the hospital schools and the anatomy schools, who were instrumental in that introduction.

Maulitz[8] has suggested that the introduction of pathological anatomy into medical education and medical practice must be viewed against the backdrop of professional changes that were being sought by the young medical men of the early 1820s. The new structures, institutions, and societies and the advent of new medical journals, all promoted, in different ways, the understanding and appreciation of the importance of pathological anatomy, and hence of general anatomy, upon which the new discipline was founded.

Mazumdar[9] argued that physiology teaching, in early nineteenth century London, followed two distinct paths. The physiology taught by the hospital surgeons was part of the clinical course, whereas the surgeon-anatomists who taught in the private schools, used physiology as a means of explaining and justifying the anatomy they were demonstrating. She maintained that, in both cases, the physiology, as taught, was an outgrowth of its institutional setting, and the work experience of the teachers. In the hospital it explained the condition of the patient; in the school, the anatomy of the cadaver. Mazumdar also maintained that it was in the private schools that what she termed "anatomical physiology" flourished and there, too, that connections were made with French research.

The distinction drawn by Mazumdar is by no means so clearly defined when the evidence of what was actually taught is examined, and when this innovation in medical education is seen in its social and political setting.

The majority of the teachers at the private schools also held clinical posts in one or more of the hospitals, although only a few of them delivered lectures there. The evidence of what was taught in the late 1820s rests either in published texts, produced by teachers from their own lecture notes; from accounts of lectures reported in the medical press; from rare examples of students' notes; or, indirectly, from the examinations set by the licensing bodies.

All the medical schools gave lectures to introduce the Medical Session 1825-26, with the exception of Mr Carpue of the Theatre of Anatomy in Dean Street. These were reported in *The Lancet*[10], with the exception of that given by Mr Mayo, of the Theatre of Anatomy in Berwick Street, who, the editor commented, objected to its publication [as will be seen below, page 90, Mayo's sense of the apposite was sometimes lacking].

Mr Dermott, of Little Windmill Street, gave, as was the custom, a well referenced history of the teaching of Anatomy, mentioning many famous men, including Meckel, Hunter and Soemmering. He included an appraisal of the current understanding of the structure of muscle

> it has not yet been proved what its essential structure consists of; perhaps its lamellae are formed of elementary fibres, too minute in size and intricate arrangement to be distinguished by common observation.[11]

Mr Brookes, of Blenheim Street, referred to Baillie's *Morbid Anatomy*[12], which, he said, without enlarging on its content, "possessed the greatest merit"[13]. Mr Sleigh, of Chapel Street, included reference to the work of Richerand, and quoted his division of the tissues

> the tissues are, the cellular, the muscular, the nervous, and the horny. He [Richerand], at the same time, ridicules, and very justly, I conceive, the doctrines of BICHAT, in which they are estimated at twenty one[14].

Sleigh set this in the context of how he would, in the ensuing course of lectures, teach anatomy by studying its component parts. He had no confidence in the microscope, though . . .

> wonderful things have been brought to light through the means of the microscope, which has made us acquainted with those atoms of living matter, that appeared destined to escape the observations of man; but neither the telescope nor the microscope has led to such beneficial results as the simple *scalpel*. . . it is much more valuable to mankind than either the telescope or the microscope, notwithstanding the ecomiums that have frequently been lavished on these instruments[15].

He bemoaned the neglect of physiology in the medical schools, blaming the Board of Examiners at The Royal College of Surgeons for failing to require attendance at physiology lectures for the award of their licence. Mr Richard Grainger, of Webb Street, speaking four years before his general anatomy text was published, referred to both Bichat and his commentator Béclard and questioned the accuracy of Bichat's *Anatomie Générale* with respect to the nervous system, expressing surprise that Bichat was not familiar with Dr James Johnston's work, published in 1764, on nerve function, which had been translated into French by Tissot. Grainger quoted the work of both Bell and Magendie on the nervous system, and paid particular tribute to Bell, but made no direct reference to the essence of Bichat's text, the textures or tissues. Mazumdar says that it seems likely that Grainger was teaching something resembling Bichat's *Anatomie Générale* to his classes as early as 1825, in view of his references to both Bichat and Béclard, but this cannot be deduced from the lecture as published.

What can be said is that he had included current research on the nervous system by both British and Continental workers. There is first hand evidence, however, that Grainger taught about the tissues at this time. The manuscript notes[16] of some of Grainger's lectures, delivered at the Webb Street School in 1826, made by William Farrant Merson, include notes on 'Common Tissues'. The tissues are divided into Cellular, Muscular and Nervous. The Cellular tissue is sub-divided into: Membrane, serous, mucous and fibrous; Vessels; and Parenchyma or solid part of the viscera, which included bone, the sheaths investing delicate structures, general connecting medium and interstitial medium. This bears some comparison with the division of Béclard on which Grainger based his own version, published in his text *Elements of Human Anatomy* in 1829[17]. As this particular note is written on the back cover of the notebook, amongst other contemporary, but unrelated material, its context within the series of lectures is not clear.

The anatomy lectures given at St Bartholomew's Hospital in 1825 and 1826 show how personal and political interests coloured the way in which new medical sciences such as general anatomy were introduced. John Abernethy [1764-1831] was surgeon to the hospital and founder of the medical school, having lectured there on anatomy, physiology and surgery, since 1791. In 1819 he had been lecturer in anatomy and physiology at The Royal College of Surgeons. He was considered a great teacher, not so much for what he said, but for the vigorous way in which he said it. *The Lancet* reported one of his lectures[18] given in the medical session 1826-7, which concerned the qualities of blood:

> With regard to *colouring matter* - O, this was said to belong to *globules* in blood. There are globules, as I told you, in the blood, and most wonderfully numerous they are. They are so minute, that I cannot believe any reports of them, when they are said to be examined by the common microscope. . . They are said to be about *the three thousand and two hundredth part* of an inch in diameter, but that is of no consequence.

His introductory lecture for the session 1825-1826[19] had contained little about the art or science of anatomy, but emphasised the importance of students attending a school connected with the practice of a hospital. An obvious reason for this was the discord between Abernethy and William Lawrence[1783-1867][20], both surgeons at St Bartholomew's, which had culminated in Lawrence joining Tyrrell in setting up a private school in nearby Aldersgate Street. Lawrence had been apprenticed to Abernethy at St Bartholomew's, had become assistant surgeon and, in 1824, a full surgeon at the hospital. His Introductory Lecture[21] for the session 1826-1827 was, therefore, given at The New Medical Theatre in Aldersgate Street. This was at a time when he was leading a public agitation against the management of the Royal College of Surgeons. Thomas Wakley [1795-1861], the editor of *The Lancet* was in the forefront of this agitation[22] and both the sentiments expressed by Lawrence and the fact that Wakley published them have to be judged in the light of this knowledge. *The Lancet* took part in a drive to replace Abernethy with Lawrence, and his reforming zeal, and the editor pointed out[23] that Lawrence had had to look to other places than St Bartholomew's to employ his talents.

The background to the antagonism between Abernethy and Lawrence, which centred on Lawrence's published lectures promoting his materialistic view of life, has been further discussed by Temkin[24] and by Goodfield-Toulmin[25], and set in the context of the social and intellectual environment in Britain at the close of the Napoleonic era by Bynum[26].

Temkin observed that Lawrence firmly believed in the dependence of structure on function, and was quite sure that there was no separate principle of life, but that he did, however, acknowledge Bichat's doctrine of vital properties, of which sensibility and irritability were the most remarkable.

Goodfield-Toulmin pointed out that, in fact, Lawrence had a very balanced view of life and of the fundamental methodological dilema facing physiology, but was chided by his opponents such as Abernethy, not only for his materialism and atheism but

> for the misguided, pernicious influences upon him of the free-thinking physiologists of Germany and France, especially Bichat.[27]

She compared the French and the English physiological methodology of the period, pointing out that it was the English, rather than the French, who were wrestling with theoretical and philosophical inhibitions.

Temkin argued that the defeat of the "sceptical party" in England, of which Lawrence was the chief proponent, in the name of patriotism and religion, gave English physiology a setting different from that of continental Europe.[28]

For the purposes of this present thesis it needs to be noted that Lawrence withdrew his lectures from circulation and thereafter confined his writing to purely medical treatises. Unlike in France, the debate in England involved men such as Lawrence, who were earning their living as medical practitioners. They would, Goodfield-Toulmin argued, have found it extremely disheartening to find themselves in the midst of a "theological" controversy every time they expressed an opinion on an issue where physiology and theology overlapped. She pointed out that in the last resort it was the patients, not the problems, that occupied them.[29]

Wells[30], too, with benefit of hindsight, remarked that Lawrence's decision to suppress his lectures was evidently a wise one in view of the fact that he went on to a brilliant career as a teacher and surgeon.

This conflict between the pursuit of physiological research for its own sake, and the need to earn a living as a doctor would be echoed later in the century when teaching, as well as research, began to demand more of a successful practitioners time than he could afford, either professionally or financially.

It is significant to note, in view of the increasing influence of the medical press, that it was in 1823, when the Lawrence controversy was at its height, that *The Lancet* was founded. Lawrence was one of the number of men in favour of reform who gathered round Wakley, its editor, who sought to uphold the interests of the medical profession. In 1827, however, having previously spoken out against its activities, Lawrence accepted membership of the Council of the Royal College of Surgeons, and his voice was thus lost to the reform movement.

Lawrence, though, in his 1826 lecture, set out clearly his view of modern medicine, one which echoed that espoused by his fellows on Continental Europe, and had its roots in the work of Bichat. He mentioned Bichat's *Anatomie Générale* as "one of the precursors of a great design which he had conceived of remodelling the science of medicine".[31] His remarks on the relationship between physician and surgeon similarly reflected those of Bichat, and emphasised his disquiet with the attitudes prevailing in London at that time.

> To the *science* of medicine, the deepest insight into the animal organisation is absolutely necessary; . . . It has been strenuously argued that minute acquaintance with anatomy is not necessary to a physician; if this be true, we shall begin to doubt whether physicians are necessary to the community. To the surgeon, however, the most intimate acquaintance with all the details of the human organisation is absolutely essential . . . without it he cannot determine the seat and nature of disease; he cannot distinguish between the affections of contiguous parts. . .[32]

Lawrence went on to list the other contributors to the series of lectures offered by the Aldersgate Street School during that session.[33] Mr Tyrrell, who also lectured at St Thomas's Hospital, was to give lectures on General and Descriptive Anatomy: "he will explain the nature and properties of those elementary structures, the combinations of which build up the various organs of the body." Lawrence advocated observation as a key to learning about disease - "you must closely watch the altered functions during life, and ascertain the organic changes by dissection after death." Finally he encouraged his students to make good use of the Continental sources of information, then more readily available, following the cessation of war, and commended to them the work of Cloquet, whose *Manuel d'Anatomie*[34], was in the course of publication, and of Meckel, whose manual of general anatomy[35] had just been translated into French.

The issue of *The Lancet* which contained the report of Lawrence's Introductory Lecture, included also that of Mr Bennett at the Little Dean Street School.[36] J R Bennett played a small but significant role in the introduction of the teaching of general anatomy in the London schools. He had graduated BA from the University of Dublin in 1817, and having studied anatomy, physiology, medicine and surgery there, had been admitted as a member of the Irish College of Surgeons in 1823. From Dublin he moved to Paris where he offered a very successful course in Anatomy on the premises of the *Hôpital de la Pitié,* teaching English-speaking students in their own language, and promoting the new French ideas and practices, using French cadavers.

Bennett's success there, however, invoked the displeasure of the French government. He then tried to set up an independent establishment, but the Royal College of Surgeons would not support his enterprise, refusing to acknowledge his certificates while lecturing in Paris, and Bennett was obliged to return to England.[37] In London, in 1825, he set up, with John Armstrong, the School of Medicine in Little Dean Street. Not surprisingly, his Introductory Lecture, delivered in October 1826, bemoaned the impediments of ignorance and superstition that continued to retard the study of anatomy in England. In France and other continental countries he pointed out . . .

> anatomy has always been regarded as the basis of the healing art; from its cultivation, the sciences of physiology and pathology have arisen to their present improved condition, and it is only through its future improvement, and the consequent advancement of these two sciences, that the practice of medicine or therapeutics can ever approach the rank of an exact science[38].

He went on to describe the tissues, using the division that Grainger had used in his lectures in the same year, namely: cellular, which included skin, mucous membranes, vessels and glands; muscular and nervous. He described the last two types . . .

> the muscular fibre is another kind of solid, different from the cellular tissue; microscopic observation shows it to consist of small globules ranged in lines, . . . The substance of nerves is also formed of globules, but different from those which form the muscle fibre.[39]

He then explained the importance of general anatomy to the study of pathology . . .

> it makes us acquainted with the characters and properties of those textures or tissues of which the human body is composed, and then demonstrates the different changes which disease induces in them. The knowledge of the alterations produced by disease in the texture of the organs, is of the first importance to the physician, particularly as it forms the basis of pathology. . Hence, even in the dissecting room, a studious observer can prosecute anatomy, not merely in its detailed description in reference to medicine and surgery, but also as subservient to pathology and diagnosis.[40]

The treatment of Bennett by the Royal College of Surgeons, whose bye-laws[41] had curtailed or prevented the professional activities of a number of well known anatomy teachers, had been brought to public attention by Dr John

Armstrong [1784 - 1829], with whom Bennett had established the school in Little Dean Street. Armstrong's pamphlet, published in 1825[42], presented an emotive case for the reform of the College, and used Bennett and Francis Kiernan [1800 - 1874] as examples of those to whom harm had been done as a result of the College's refusal to recognise their certificates of attendance. The pamphlet stimulated considerable editorial comment in *The Lancet*, both at the time of its publication, and later in 1831[43], after Bennett's death. An unsigned review[44] of the pamphlet points out that Bennett, whom Armstrong had represented as one of the ablest and best of men, was unknown to the majority of the profession. Bennett, though, and the issues he represented, remained in the public eye. In March 1826 a paper in *The Lancet* on "The French System of Surgical Education contrasted with the English", had appended to it the comment "for this history we are indebted to *Mr Bennett*, who, for several years, taught anatomy in Paris and is well qualified to write on the subject."[45]

Armstrong, an Edinburgh graduate was a successful and popular teacher[46]. In 1821 he had joined Grainger at the Webb Street School, and after setting up the Little Dean Street School in 1826, continued to lecture in both establishments. His lecture at the Webb Street School, given in June 1827[47], introduced one of the earliest courses of lectures given specifically on morbid anatomy, based on the tissue concept of Bichat. He told his students that the course would consist of

> a series of particular lectures on each of the acute affections successively, of all the important parts of the body, with reference not only to the conditions of the solid textures, such as mucous, serous, fibrous and so forth, but also to those changes of the fluids, especially of the blood .[48]

In the same medical session a particular tribute was paid to Bichat and to his *Anatomie Générale* by James Wardrop, an associate of Lawrence at the Aldersgate Street School. In his lecture[49] on the classification of diseases he demonstrated that a knowledge of the textures or tissues was a prerequisite for a knowledge of pathology. He credited Bichat with foresight . . .

> it is clear that Bichat himself foresaw the influence which the splendid general views he had given of the natural structure of the body would ultimately have in the investigation of diseases, and had he lived, he would probably have pursued

> pathological anatomy with as much zeal and success as he had investigated the natural structure; and further, that his researches would have led him to form a new arrangement of diseases. . .[50]

He continued . . .

> His *Anatomie Générale*, I consider, one of the most remarkable productions which has ever appeared in medical science, having opened a path of investigation which can scarcely be said ever to have been trodden before, and which has laid the foundations of a new anatomy, a new physiology, and I may add, a new mode of investigating diseases. [51]

He described Bichat's work, giving details of his twenty one tissues and his modes of enquiry, and commented . . .

> it is not to be denied that he must have derived important hints from the previous labours of Hunter . . . I have reason to believe, from a very interesting conversation I once had, with a particular friend and companion of Bichat, that he worked alone, and that the numerous volumes he has published are to be chiefly considered as the labours of his own ingenious and comprehensive mind.[52]

Wardrop's object, he said, was

> to show the effect of Bichat's arrangement in forming a pathological or nosological system, and demonstrating that the symptoms of morbid change were the same in similar textures, in whatever part of the body they were to be found.[53]

Wardrop[54], who had been educated in Edinburgh and on the continent in the first decade of the century, took a leading part in the discussions of 1826-1827, on the state of the medical profession. He was an active supporter of Wakley and of Lawrence. In 1826 he had founded, with William Willocks Sleigh, the charitable West London Hospital of Surgery, which was not recognised by the Royal College of Surgeons. It is interesting to note that when, in that year, the post of Surgeon at St George's Hospital became vacant, following the resignation of Everard Home, both Sleigh and Bennett applied but were not considered.[55]

It may seem from this account that General Anatomy was well established in the repertoire of the London medical teachers, but this is not necessarily the case. Those lectures printed in *The Lancet* were selected by the editor, Wakley, who would have promoted those seen to be supporting his own reforming zeal. In the 1825-1826 session, for example, the introductory lecture of Bell at the Great Windmill Street School was given little space, and that of Headington at The London Hospital, none at all. Neither of these was likely, having no quarrel with the College of Surgeons, to speak out against its practices. Wakley apologised[56] for the "imperfect reporting", explaining that there was a lack of men to report on lectures, all of which took place at the same time.

That general anatomy was closely linked with professional and educational reform, and that there was significant reference to it in the reports of the 1826 -1827 introductory lectures, suggests that the idea of its essential contribution to the curriculum began then to be established.

The textbooks available

Not all the medical teachers who espoused the concepts of Bichat had enjoyed a continental education. Many relied on the range of published material which the advent of more sophisticated printing techniques had rendered less costly. For foreign sources the channels of communication had become easier following the end of the war with France, and major texts were available in London. Maulitz has pointed out[57] that there was a crucial relationship between pathology as an evolving body of knowledge and the evolving medical journal, and that the relationship was a reflexive one, each needing the other. Pathological anatomy, he said, was one of the new fields whose importance served as the rationale for the growth of the medical publishing industry. The medical periodicals, in particular, acted as purveyors of information and as platforms for comment and review. They not only reported the British scene but gave rapid and direct access to foreign material. The impact of medical periodicals, and of their editors, on medical knowledge and the medical profession in general has been well documented[58].

Publications were advertised in the medical journals and several libraries enabled not only students but practitioners to gain access to new materials. In 1824, Highley advertised in *The Lancet* . . .

> S HIGHLEY begs to inform the Gentlemen attending the Medical Schools in the Borough, that he has been induced to open a LIBRARY, in a situation convenient to the Hospitals, which will be supplied with the Medical Journals, and daily Newspapers, and to which the Students will at all times be admitted. Mr Highley begs leave further to state, that all Medical Works, Class and Lecture Books, may be obtained at the Library, or at 174, Fleet-street.[59]

In January 1824, Highley announced[60] his publication of the first part of Bichat's *General Anatomy* which had been translated from the French[61]. This included the first two volumes and was offered at sixteen shillings. The second part appeared in April 1825. *The Medical Calendar*[62], published in 1828, gave details of medical libraries open to students, including those at the British Museum, the London Medical Society, the Medico-Chirurgical Society, and those attached to the Physical Society at Guy's Hospital and the Westminster Medical Society. It also listed four Medical Circulating Libraries in the neighbourhood of the principal hospitals. By 1832, twelve London medical booksellers were listed in *The Lancet*[63], five of which specialised in foreign books.

It was not only foreign books on general anatomy that were sought by students, however. Bostock's *Elementary system of Physiology*[64], discussed above, was a popular treatise, first published in 1824, and which, within a decade had reached its fourth edition. The text, written while Bostock was a lecturer in chemistry at Guy's Hospital, received a muted tribute from his biographer[65], who remarked that it was . . ."a book which was a good deal read till the publication of Baly's translation of Müller's 'Physiology', but is now merely an obsolete text-book."

An equally guarded comment was made[66] on the work of Herbert Mayo [1796-1852] . . ."his work on Physiology, although now superseded by more modern productions, will always be remembered with pleasure by those who read it.". Mayo, together with Sir Charles Bell [1774-1842], his tutor, and R D Grainger, best fit Mazumdar's descriptor as "anatomical physiologist"[67], those men who, when working in the private medical schools, used physiology to explain and justify the anatomy they were demonstrating. Mayo's medical training was fairly conventional. He was the son of a London doctor, and entered the Middlesex Hospital in 1814, as a surgical pupil of Bell. He studied and graduated MD at the University of Leiden and became house surgeon at the Middlesex Hospital in 1818. In 1819 he became a Member of The Royal College of Surgeons.[68] In August 1822, Mayo published his *Anatomical and Physiological Commentaries*[69]. In the introductory statement of his text Mayo, in his clear style, made an observation on the "vital principle", challenging Bichat's theory in relation to sensitivity and irritability. . .

> Bichat indeed was the first who saw distinctly that Physiology admitted of rigorous principles, yet he failed in his attempt to elucidate them. As I am not aware that any individual has pointed out the errors of Bichat's system of vital properties, I will state some objections to it, which have doubtless occurred to many.[70]

Mayo failed to mention Bichat's application of the vital principle to general anatomy.

It was in his *Outlines of Physiology*[71], published in 1827, that he dealt systematically with the structure and function of the body. Mayo had, in 1826, purchased, with Caesar Hawkins, Bell's interest in the Hunterian or Great Windmill Street School, where he lectured in anatomy. The *Outlines* were the "heads of the Physiological Lectures delivered by the Author in the School of Great Windmill Street, together with a short account of the structure of the principal organs of the human body."[72] It is interesting to note that although Mayo described himself, on the title page of the volume, as Lecturer in Anatomy, his text was one on physiology, which supported the anatomical content. Mayo's view of the role of physiology and pathology complemented that of teachers such as Bennett. In his *Advertisement,* which introduced the text, he said . . . " He who is acquainted with the healthy structure and function of the body, is qualified to investigate disease".[73]

The book dealt systematically with each system of the body and included details of general anatomy, and referred to current research. In the chapter on the blood he mentioned the work of Young, Bauer, and Wollaston and quoted Prévost and Dumas[74]. He stated that . . .

> The colouring matter of the blood is connected with innumerable globular bodies, which are readily discerned with the assistance of a microscope upon examining serum, in which a portion of the coloured clot has been broken down. In a drop of blood the globules are too numerous to admit to their being distinctly seen . . [75]

On muscle, he quoted Everard Home and Bauer[76], Prévost and Dumas[77] and mentioned Bostock's text. He then stated . .

> if the portion spread out to the greatest tenuity be examined in a microscope, the fibres at one part or another are distinctly seen to consist of numerous minute threads of uniform size. As these threads appear to admit of no further subdivision, it is presumable that they constitute the primary filaments of muscular substance . . . If the primary filaments be now viewed under a varied light, by altering the inclination of

> the mirror attached to the microscope, or by shading the light with the hand, another circumstance becomes apparent at one point or another of the surface; the filament, instead of presenting a perfectly even outline, is seen to be regularly indented, and faint cross shadows upon its surface, more or less clearly distinguishable, show that it consists of cohering sphericles, which are nearly equal in size to those of blood.[78]

The sentence quoted seems to the present author to be of great significance in the history of histology. By tilting his mirror he secured what would later be called oblique illumination, and by putting his hand into the light path he may have secured a form of darkground illumination. By careful observation of the greater contrast in the specimen thus obtained, Mayo clearly observed that the fibrils were filaments and not globules, and also that they carried striations. However, with the globular theory being so widely accepted at the time, he then interpreted his structures as globules. This remains a very early observation of striated muscle fibres, to which, before now, attention seems not to have been directed. It is all the more remarkable for having been made with non-achromatic lenses.

In the second edition of 1829[79], after the publication of Hodgkin and Lister's key paper[80], Mayo described blood . . " the colouring matter of the blood resides in innumerable particles, which are readily discovered with the assistance of the Microscope", and then a figure, showing drawings of particles of human blood, was inserted in the text, with the comment . . ."I made this drawing very recently from particles of the blood seen in a microscope made by Dollond, having two achromatic object glasses".[81] [See Figure 1]. The figure is an engraving, printed subsequently to the rest of the letterpress text of the page. This is the first accurate drawing, in an English medical text, of red blood corpuscles as seen under a compound microscope; earlier writers, although giving clear and accurate descriptions, made no attempt to represent them graphically.

His section on muscle, too, reflected the advances made in lens construction. He compared what was seen with what he described as an ordinary microscope [non-achromatic] with what was revealed with one which has lenses corrected, as it would now be termed, for both chromatic and spherical aberration . . .

assistance of a microscope, upon examining serum, in which a portion of the coloured clot has been broken down. The form of these particles may be compared to that of a silkworm's egg: they are flattened, have rounded edges, and a central depression on either surface: their diameter is very exactly $\frac{1}{3000}$ of an inch. They are flexible, and when rolling upon their edges are often bent in such a manner that they appear to consist of a central nucleus projecting from a thin disc. Their specific gravity Dr. Davy estimates at about 1087.

The adjoined figure represents six squares of a glass micrometer, each side of a square being $\frac{1}{500}$ of an inch. In the squares marked 1, 2, and 3, different appearances of the particles of human blood are delineated, showing their diameter, their central depression, and various positions in which they may be seen when rolling down an inclined surface. I made this drawing very recently from particles of the blood seen in a microscope, made by Dollond, having two achromatic object glasses. The true shape of these bodies was, I believe, discovered by Dr. Young, who describes it in an essay published in his Medical Literature. Figs. 4, 5, 6, represent the particles of the blood of a skate: they appear to differ from the particles of human blood principally

Figure 1.
H Mayo - *Outlines of Human Physiology*
London: Burgess and Hill, 1829.
Page 28.

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When a muscular fibre is well seen in an ordinary microscope, it appears made up of longitudinal filaments, each consisting of a string of globules, about 1/8000th of an inch in diameter: or the fibre appears marked by indented and ill-defined cross shadows, placed at that distance apart. But with a better instrument, such as that which Mr Lister possesses, the delusion vanishes, and the parallel lines, which traverse the fibre, appear perfectly clean and even. Mr Lister politely gave me the opportunity of examining this appearance, which was discovered by himself and Dr Hodgkin.[82]

The career and work of Mayo were closely linked with that of Bell[83]. Bell published, while a student in Edinburgh in 1798, *A System of Dissection,*[84] illustrated by his own drawings. In 1799 he was elected Fellow of the Royal College of Surgeons of Edinburgh and became one of the surgical attendants at the infirmary. He had, in 1804, with his elder brother John, an anatomist and surgeon, published an *Anatomy of the Human Body.*[85] He came to London in the same year in search of professional advancement, and with valuable introductions to prominent members of the profession. In London, he obtained an appointment at the Middlesex Hospital, and also taught anatomy privately in his own home. In 1810 he bought Hunter's old school, and it was there, at what became The Great Windmill Street School, that he pursued his anatomy teaching and his work on the nervous system. Bell's lectures at the Royal College of Surgeons[86] and his papers read before The Royal Society[87], rendered him well known and respected in London medical circles. He was knighted and, in 1829, received a medal of The Royal Society for his work on the nervous system. Bell exposed nerve tracts by fine dissection and did not use a microscope in his work. It is his role in the establishment of posts at the new University of London [see page 49 below] which make him a significant figure in the early history of the introduction of general anatomy into the medical curriculum in the London schools.

Richard Dugard Grainger, too, was a surgeon-anatomist whose strength lay in his work in a private anatomy school. His *Elements of General Anatomy*[88], published in 1829, has already been cited as the first English text on general anatomy. Grainger was the proprietor of the Webb Street School. He was the son of a Birmingham surgeon, and had been entered as a cadet at the Military Academy at Woolwich. His brother Edward, together with Dr John Armstrong, Dr Southwood Smith and others had established the flourishing

School at Webb Street, but, when Edward's health began to fail, Richard joined his brother, and was trained as a teacher of anatomy, physiology and surgery. At the age of twenty two, Richard Grainger succeeded his brother at the school.[89]

His biographer described the *Elements* as "one of the earliest attempts to give a lucid view of human physiology, connected with the minute structure of parts as ascertained with the microscope"[90]. In the preface to his text Grainger explained that his object had been . . .

> to convey a concise, and at the same time a comprehensive account of the several substances which form the human body . . . to the description of the different tissues, some observations on their use are added, for the purpose of shewing how admirably each structure is adapted to the functions it is destined to fulfil . . . In the present day, when morbid anatomy is so zealously cultivated, the kind of information included under the term *General Anatomy* is essentially necessary; because it is impossible to appreciate the changes produced by disease in the various parts of the body, without being previously acquainted with their natural and healthy structure.[91]

Grainger was not comfortable with the term 'General Anatomy'. He said that he had been guided by the example of three of the most eminent authorities of modern times, Bichat, Béclard and Meckel, who had employed the term to designate that branch of anatomy "which had for its object the investigation of tissues". He felt that the term "in its strict acceptation, comprehends everything that relates to the science of organisation", but that custom had sanctioned its more limited meaning.[92]

A review of the text in *The Lancet*[93] described the work as useful and well-written and judged that it would long maintain the first rank amongst work of a similar description. It approved the junction of anatomy and physiology, thought the general arrangement good and the language clear and concise. It regretted that Grainger had given so much on the authority of others and too little of his own observations and experiments. In fact, Grainger certainly quoted other workers, and was not afraid to challenge their observations. Having, for example, quoted from Meckel's *Manuel d'Anatomie*[94], a passage which described the structure of the globules of which the textures were composed, he explained . . .

> I have made this extract, because it presents the opinion of one of the first anatomists of Europe; but it is doubtful if some parts of it are correct, at least they are directly opposed in several respects to the careful investigations of M. Milne Edwards, in

France, and to those of Dr Hodgkin, in England. The former thinks that he has established the following laws:-
1. That the elementary structure of the following tissues is identical in all animals; viz., the cellular, the fibrous, the muscular, and the nervous.
2. That this elementary structure is globular, the globules having the same form and the same size, whatever may be the animal or organ in which the above tissues are examined. He considers these corpuscles to possess a spherical form, each having a diameter of 1/300th of a millimetre.
The observations of Dr Edwards are the result of such cautious and repeated examinations, that it is scarcely possible to doubt their accuracy. In the year following their publication, they were, however called in question by Dr Hodgkin. This gentleman, who has employed a most perfect microscope, constructed by Mr Lister, denies the globular structure of those tissues, which have been supposed by the highest authority in these matters, to possess that arrangement in an eminent degree; for example, the muscular, nervous, and cellular fibres [95].

Grainger made several references to the work of Hodgkin and Lister[96] and showed that he had attempted to replicate their observations . . . "I have made several microscopical observations upon this fibre, and I have noticed a great number of delicate lines marking it transversely, but no globules."[97]

Grainger gave a history of the way in which investigations on the composition of the animal body had been carried out since mid-eighteenth century. He quoted Andrew Bonn's thesis of 1763[98], Carmichael Smyth's paper on inflammation, read in 1788[99], and that of Pinel in 1788[100]. The ideas of Bonn, Smyth and Pinel, he said, had been seized on by Bichat, who, on this slight foundation, had produced a history of the composition of the human body which was one of the most important works that had ever appeared relative to medical science . . . "The *Anatomie Générale* has been received through Europe as the very foundation of the branch of knowledge upon which it treats. . ."[101]. [In 1979, Keel undertook an analysis of the work of these men to determine their original sources[102]].

Grainger listed Bichat's twenty one tissues and discussed Bichat's classification into general and particular tissues, pointing out that this arrangement was the basis on which more recent classifications were founded. He went on to give his own preferred arrangement of eleven categories of tissue : Cellular; Serous; Cutaneous; Vascular; Glandular; Cartilaginous; Fibrous; Osseous; Muscular; Nervous and Epidermoid. He also appended the arrangements favoured by Chaussier, Dupuytren, Magendie and Rudolphi. The main part of the text followed, a chapter dealing with each type of tissue in terms of quantity; location; organisation, divided into observation with the naked eye and with the microscope; chemical composition; properties and functions.

Following his microscopic account of the ultimate fibre, he sought to explain why observers of animal structure had seen different images . . .

> In reviewing the preceding statement the reader will be struck with the discrepancies it presents, and which display a humiliating exemplification of the imperfection of all our attempts to determine the intricate structure of the animal body. But much of this contradiction I believe to be only apparent, depending on the successive improvements that have been made in the powers of the microscope. It is probable that physiologists from the time of Leeuwenhoek, have described what they really saw with their defective instruments; so that if we reject the speculative arguments which were founded on these imperfect observations, a general resemblance may be traced throughout their descriptions. Is it not, for example, probable, that the rhomboidal vesicles of Borrelli - the series of pearls observed by Hooke - the rounded corpuscles of the Wenzels, and the wrinkles noticed by Prochaska and Fontana, are in reality the identical structures discovered by the powerful microscope of Lister?[103]

In his preface, Grainger observed that just at the point when his manuscript was finished, Craigie, of Edinburgh had published his *Elements of General and Pathological Anatomy*[104], but, having made such progress, and having agreed to complete it, he carried on with his own work. Craigie's book, which dealt with "minute structures and their morbid alterations" was reviewed in *The London Medical Gazette*[105], which reported that . .

> The arrangement adopted by Dr Craigie is a modification of that of Bichat, in which he has availed himself of the labours of the most able commentators, especially Béclard . . . additions of our knowledge of morbid anatomy have been so extensive within the last few years, and the materials lie scattered in situations so numerous, and many so difficult of access, that a work intended like the present to collect all that is known on the morbid anatomy of different textures under one head, cannot fail to be very useful . . ."

David Craigie [1793-1866] was an Edinburgh physician, who had graduated there in 1816[106]. His biographer was not impressed with his career . . . "He never attained great practice nor was he a famous teacher" . . . nor with his text . . ." It shows that he read many books on morbid anatomy . . . its defect is a want of that familiarity with diseased structures which can only be acquired in the post-mortem room.". Even so the book went to a second, enlarged, revised and improved edition in 1848[107]. Craigie became the owner of *The Edinburgh Medical and Surgical Journal*, and edited it himself.

It was in this journal, prior to Craigie's editorship, that a detailed, critical analysis of Grainger's book appeared.[108] The review considered Grainger's text in conjunction with Bayle and Hollard's *Manual of General Anatomy*[109], but no mention was made of Craigie's work. Grainger's was said to be the more complete of the two texts, with Bayle and Hollard's . . ." by no means contemptible or useless; and we believe it may answer the purpose of giving the student, when just commencing the study, a good idea of the nature and objects of general anatomy". Grainger's content was set out in tabular form, to show its similarity to that of Béclard. The reviewer pointed out that in the composition the same system of imitation could be recognised, although Grainger had occasionally introduced matter from English authorities and from recent enquirers . . . "the chief novelty of this section is the introduction of the transverse lines, recognised in muscular fibre by Dr Hodgkin and Mr Lister." Paragraphs of Béclard's French text were juxtaposed with the English of Grainger to show that the distinctions, nomenclature and language of the foreign author had been adopted, and to indicate that the work was by no means original. This acerbic comment concluded that Grainger could have adopted no better model than the work of Béclard, that the text was useful and that the anatomical reader would pursue it with interest and advantage. Both the style and content of this review point to its authorship. Robert Knox had translated Béclard's *General Anatomy* in 1829, the same year in which both the work of Grainger and that of Bayle and Hollard appeared; Knox's colleague and biographer, Lonsdale, made similar comments on Grainger's work in his account of Knox's working life. It seems likely, then, that Knox, at a time of great pressure, with the 'Burke and Hare' scandal at its height[110], wrote the article which was so critical of his two fellow authors.

It was not, however, Grainger's text, nor yet Knox's translation of Béclard, that was to stand the test of time, but that of Jones Quain [1796-1865] who was born in Ireland and graduated from Trinity College, Dublin, first in arts and then in medicine[111]. He went from Dublin to Paris where he worked in the medical schools and, while there, translated Martinet's *Manual of*

Pathology[112], which was published in London in 1826. Martinet, in common with his French colleagues, considered general pathology, physiology and anatomy to be the indispensable sciences. He pointed out that if one was ignorant of the healthy state of the tissues, it was not possible to recognise them in a diseased state. Nor, he said, could the effects of disease be distinguished from those occurring after death, if the anatomical characters peculiar to each tissue were not known.[113] Quain's translation went, in 1827, into a second edition, to which he had added notes and additional material[114]. He had, by this time, left Paris and had joined the Aldersgate Street School, in London. His new edition earned him a glowing review in *The Lancet*[115]. The reviewer first paid tribute to Bichat . . .

> The system of General Anatomy, which was developed by the stupendous genius of Bichat, has been made the ground-work of this admirable treatise on Pathology, which, in its original state, must be well known to every one conversant with the foreign literature of his profession.

Quain's skills were then applauded . . .

> The elegant translation of this Manual by Mr Quain, already so well known to the profession as the Demonstrator of Anatomy in the Aldersgate School, has been enriched throughout with many judicious and original observations. In this improved state, the work is eminently calculated to supply the deficiency in the study of pathological science, which has long been experienced in this country . . .

Quain's reasons for the necessity of studying general anatomy were quoted

> As a consequence of their striking similarity in structure, properties, and anatomical characters, these membranes are ranged under one head, and form one class, so their diseases should also form one group . . . these considerations point out some, at least, of the advantages of studying general anatomy - they indicate, at once, a mode of arranging diseases according to a natural method, by grouping them together according to their natural affinities, and thereby introducing into medicine . . . rigorous methods of investigation.

The review recorded that, after lamenting the want of any English work on general anatomy, the author had given the "gratifying intelligence" that he was engaged in one that would speedily appear, which, the reviewer adds, " considering his cultivated mind, and his great knowledge of every department of anatomy, will doubtless become a standard book"[116].

Such a eulogy, to a man of only thirty years of age, and only recently arrived on the London scene, is surprising, but prophetic, since Quain's *Elements of Anatomy* did indeed become a standard work, and remained so, through its various editions, until the end of the century.

Elements of Descriptive and General Anatomy: for the use of students[117] was published in 1828. Quain's object, he said, was to give a condensed and methodical description of the different structures and organs; to point out the most convenient method of conducting their anatomical examination; to indicate some of the more important practical applications that could be made of the facts disclosed during investigations and finally to present abridged summaries "of the most instructive principles of General Anatomy"[118]. This he did, in his first edition, following a general introduction, by devoting the first chapter to a description of organised bodies, fluids and solids, together with an explanation of the terms used, and then by devoting each succeeding chapter to a detailed examination of a specific region of the body. In his introduction he referred to Béclard and Meckel, and demonstrated Meckel's mode of division of tissues and the arrangement of his work, with reference to the liver. He said that Meckel could be considered to have laid down the plan and scope of the course of instruction which should be given by teachers of anatomy, if they intended them to be at all commensurate with the current state of anatomical science. His description of anatomy closely resembled that followed by Bichat . . .

> Anatomy, or rather the process of dissection, resembles that of analysis, as its object is to resolve a part, or the whole of an organised structure into its proximate constituents, in order to ascertain their outward conformation, volume, relative proportions and physical properties.[119]

In his clear and confident style Quain explained that his work was the substance of the courses of anatomical demonstrations which he delivered at the Aldersgate Street School, and arranged on the same plan. He brought just three source books to his students' notice: that of Meckel, in its French edition; Bichat, with additions by Béclard; and Béclard's own treatise.[120] Quain's treatment of general anatomy was confined to his first chapter. He gave the current description of 'globules' and referred to Milne Edwards' work[121] as an indication of his own view that the circumstances which determined the way in which tissues were organised was still to be determined. He then adopted and described Béclard's threefold division of the tissues: the Cellular, the Muscular and the Nervous.[122]

Subsequent editions of the text, in 1832[123] and 1834[124], produced when Quain was Professor of Anatomy and Physiology at the University of London, had a new title, *The Elements of Anatomy*, and a new publisher. The text was no longer arranged regionally, but the body described system by system. The second edition included a reference to Hodgkin and Lister's paper[125], together with the author's own view of the cause of the optical illusion . . . "most probably the bead-like or globular structure attributed so generally to muscular fibre, is but an optical illusion, owing to the shadows produced by the transverse lines just noticed."[126] His list of approved texts had been extended to include Knox's translation of Béclard, and the works of both Craigie and Grainger.[127] In his third edition the physiological text of De Blainville is cited, together with a list of monographs and essays, which included that of Bostock, and also Hodgkin's translation of Edwards.[128]

A review of the first edition of Quain's text appeared in *The Lancet*[129], and was, again, fulsome in its praises . . .

> The excellence of the author's plan, is equalled only by the extreme fidelity of its execution; the work, indeed, is a splendid performance; the anatomical descriptions are written in a style, at once forcible, vivid, and elegant, and the observations on surgery, are evidently based on a thorough knowledge of morbid anatomy. This book must prove invaluable to students engaged in dissection, and scarcely less valuable to the established practitioner. - Mr Quain, if we mistake not, will reach the summit of his profession.[130]

University College

The same issue of *The Lancet* which carried this review had devoted its editorial comment to the opening of The New Medical School at the London University. The origins and establishment of the University of London have been described in detail by Hale Bellot[131], and we need set out here only those events which concerned the beginning of the teaching of general anatomy in the new medical school. It will be seen that the struggle to secure the honour of teaching that aspect of the medical curriculum was a key issue in the early years. [For the sake of clarity in this thesis, the institution will be called University College, other than in quotations, even though it did not receive this appellation until 1836].

The college came into formal existence on 11 February, 1826, and its original Prospectus declared that . . .

> Medical Education would be improved if the teachers of the most distinguished ability who are now scattered over London, were gradually attracted to one institution, where they would be stimulated to the utmost exertion of their faculties, by closer rivalship, larger emolument and wider reputation.[132]

Mazumdar has suggested, however, that the local teaching was not what they actually wanted, but that the medical school was to be formed upon the model of the German schools.[133] It was proposed to offer courses in the complete range of medical sciences, including, amongst others, anatomy, physiology, surgery, and the nature and treatment of disease. An account of the deliberations of the Education Committee and of their recommendations to the Council is recorded in the Minute Book for 1826 and subsequent years.[134] The Education Committee included George Birkbeck [1776-1841] as its only medically qualified member.

It was decided, in December 1826, to advertise for applications for professorships, responses being sought by the following May[135]. The original eleven applicants for the chairs of anatomy, physiology and surgery included some familiar London figures - James R Bennett, Herbert Mayo, James Wardrop and William W Sleigh. Lesser known applicants included Thomas King, then teaching in Paris and J E Spry, who offered himself as a demonstrator[136]. The names of Mr Charles Bell and Mr G L Pattison were, however, proposed to the Council, by the Education Committee, for the chair of Anatomy and Surgery, and that of Dr P M Roget for Physiology and Comparative Anatomy[137]. A list of criteria was drawn up by the Committee, who considered it necessary that the Council should satisfy themselves on the following points with respect to each candidate: the candidate's knowledge of the particular subject; his having had a liberal education; his experience as a public lecturer; his experience as a private tutor; his experience in the management of apparatus and in the exhibition of experiments; his age; his moral character; his not having made himself remarkable by the avowal of objectionable opinions in religion; his temper, his position and manners and personal appearance.[138]

On 28th June, 1827, the Education Committee discussed a letter which had been received from the renowned Professor Meckel in Halle, stating his wish to become a candidate for the chair of Anatomy. This was undoubtedly a considerable accolade, since Meckel would have brought great prestige to the new institution. On that same day it was decided by the Committee to recommend that the Council confirm the appointments of Bell and Pattison, without delay[139]. Five days later it was further resolved to recommend that Meckel be named joint professor of anatomy with Pattison[140].

The *First Statement* by the Council, in 1827, which explained the nature and objects of the Institution, included the statement that the chairs of Anatomy and Physiology, Morbid and Comparative Anatomy, and Surgery, would be filled by: Charles Bell, Esq., FRS, FLS, Professor to the Royal College of Surgeons; John Frederic Meckel, MD, Professor of Anatomy and Physiology in the University of Halle in Saxony; Granville Sharp Pattison, Esq., late Professor of Anatomy and Surgery in the University of Maryland, US.[141]

This proud list was somewhat presumptuous. Bell had assumed that he would play a prominent role in the new Medical School[142], and, as the distinguished head of a major London school for fourteen years, during which time he had successfully taught anatomy and physiology, had reason for this belief. He would not have expected to be appointed jointly with two others! He had, as he reminded the College later, "been applied to, in the most flattering manner, to become connected with the University . . . I was to be at the head of the medical school, and to occupy a distinguished place in it . . "[143]. Pattison [1791-1851], was virtually unknown in London. He had been admitted a member of the faculty of physicians and surgeons of Glasgow in 1813 and had, in 1818, assisted at the Andersonian University in that city, prior to leaving for Philadelphia, where after teaching privately, he had occupied the chair of physiology and surgery in the University of Maryland for five years. He resigned this post on grounds of ill health and returned to London in 1827, where he did some lecturing for Birkbeck at the Mechanics' Institution[144].

Meckel's letter had not been sent directly to the Council, but by way of a friend, Mr J E Spry, a surgeon, who lived near Red Lion Square. When, on 12th July, 1827, a letter of appointment as Professor was sent to Meckel[145], it was again transmitted through Mr Spry. It is not at all clear why an intermediary was used, either by Meckel, in his initial expression of interest, or by the College on future occasions. A covering letter from Leonard Horner, the College Warden, to Spry, explained that

> the reputation of Professor Meckel stands so high that the Council did not consider it necessary to have any more formal application from him than that which he makes in his letter of the 19th May, addressed to you, and which you transmitted to the Council . . . they will be most happy to treat with him about his collections, upon the basis which he suggests in his letter to you. You may inform Professor Meckel that the Council will secure £300 a year for him . . . Professor Pattison, who has been appointed by the Council, Professor of Anatomy, will set out in the course of a few days to confer with Professor Meckel . . . I beg the favour of you to forward the letter by the post this evening . . .[146]

Pattison had, as a letter from Horner implied, offered to go to Frankfurt, to inspect the collection of Soemerring, which was for sale. Horner asked Pattison not only to go to Frankfurt, but also to go on to Halle to describe Meckel's collections, to estimate their value, and to judge how well they might travel. Horner stated that "Professor Meckel has been appointed, as you are aware, Professor of Physiology and of Morbid and Comparative Anatomy"[147]. It was not until Pattison had arrived in Frankfurt that Horner wrote to inform him that Bell had been appointed Professor and that "as soon as you, Mr Bell and Professor Meckel shall have an opportunity of consulting together, the particular departments which you take will be settled."[148] This must have come as very unwelcome news to Pattison who had left England considering his post as Professor of Anatomy secure; indeed, his letter of appointment[149], dated 12th July, stated that fact. Bell's letter from Horner must have been equally disconcerting . . .

> The Council . . . have this day elected you joint professor of Anatomy and Physiology, of Morbid and Comparative Anatomy and of Surgery, with Professor Meckel and Mr Pattison . . . In using the term 'joint' Professor, you will understand that it is the intention of the Council that the subjects enumerated are to taught by yourself, Professor Meckel and Mr Pattison, the particular department to be assigned to each will be a matter of subsequent arrangement . . .[150]

It is interesting that the Council had not formally offered Bell a post until this stage, nor, having encouraged Bell to develop his museum for the College, thought to inform him about Pattison's visit to Germany. . .

> When I had been . . . induced to increase my museum of anatomical preparations, for the use of the University, I found the Council sending a gentleman to the continent for the purchase of a museum. That expectation failing, they returned to me . . . [151]

Pattison wrote directly to Brougham saying how sorry he was to hear that the Council had changed its mind in the manner in which it was to appoint its professors and emphasising that he was most anxious to occupy the anatomical department.[152]

It is not difficult to imagine Pattison's reluctance to paint a glowing picture of Meckel's prospects in London. Pattison reported back to the College that Meckel was unwilling to give up a chair in his native country where he was so distinguished, unless he could be assured that his circumstances would not be injured . . . "Professor Meckel is of the opinion that he could not live in London in a manner suitable to his rank . . . [on] less than £1000 . ."[153] . Meckel had clearly decided that he would move to London only on his own terms. In retrospect, these seem to have been so onerous, and so inflated from his original suggestions as to be designed to be quite offputting to the College Council.[154] Pattison carried on a blunt correspondence with Meckel while he was in Europe. From Berlin he had written to Meckel to tell him that he did not think the Council would listen to what he, Pattison, considered to be most extravagant demands . . .

> as the highest talents in Great Britain can be induced to give up valuable situations and accept of Professorships in the University of London without any assurance of income they do not feel themselves placed in the predicament to be obliged to retain Gentlemen from abroad, no matter how distinguished they may be, by extravagant offers.[155]

Pattison was wrong, however! The Education Committee now resolved that

> considering the high reputation of Professor Meckel and the circumstances of his leaving his native country, he be offered an income for his professorship of £1000 per annum, and should his fees exceed that amount, whatever more he might derive from that source.[156]

This could only have enraged both Pattison and Bell still further, being in remarkable contrast to the arrangement proposed for the holders of the other medical chairs, namely, £200 per annum, until the cost could be recovered by the receipt of student fees.[157] Pattison also felt that he should pass on to the Council information

> which may militate against his [Meckel's] appointment. But in offering these I beg leave to observe that . . . they are merely reports and, as envy and jealousy have erected a feeling of hatred against the Professor amongst his brethren in Germany, they are to be received 'cum grano salis'. For my own part I would not place the weight of a feather upon them."

He then detailed Meckel's shortcomings; his lack of talent for teaching; his bad manner; his confused arrangements, his irritable temper; that if appointed he would keep the medical faculty in a constant state of irritation; and the impossibility of his becoming a popular lecturer on account of his lack of command of English. Pattison's only positive comment was on Meckel's ability as a comparative anatomist.[158] Meckel took exception to Pattison's letters and wrote to Horner, who distanced himself and the Council from Pattison and assured Meckel that his communication . . .

> will meet with that attention from the Council to which a person so eminently distinguished as you are entitled; the more especially in your case, as I know that the Council are most desirous of adding lustre to the University by ranking you among its professors, if the inducement which they have in their power to hold out are such as you can accept . . . [159]

Meckel still made no decision about moving to London. The Council were, no doubt, distressed that their efforts to secure such an eminent man to one of their medical chairs seemed to be failing.

It is possible that Pattison's role in the matter would have been played down, had not Dr Augustus Bozzi Granville, FRS, a well known physician and accoucheur, followed in Pattison's footsteps and visited both Meckel and Soemmering that summer. His account of the affair was published under the heading 'Meckel and the London University' in *The London Medical Gazette*[160]. He gave a detailed description of what he purported to be Meckel's view of the events, including the suggestion that unsolicited and desultory offers had been made to Meckel from London but that he had never been a suitor for the chair. Meckel accused Pattison of incompetence. Pattison leapt to his own defence in the following issue of the journal, quoting details of the correspondence between all the parties concerned. Such exposure in the medical press can have done little to enhance the reputation of the College, but it afforded Pattison the opportunity, once again, of stressing that Meckel was a Comparative Anatomist rather then an Anatomist, by profession. Dr Granville had been an unsuccessful candidate for the chair of midwifery at the College, and it was rumoured that Brougham had suppressed Granville's testimonials in favour of those of Davis, Mrs Brougham's physician. This could well have prompted his mischievous report.[161] The Committee was meeting even more frequently at this stage, sometimes two or three times each week. In December 1827 the Council lost patience and wrote to Meckel, inviting him either to accept or reject their offer. He declined it[162] .

The opportunity, therefore, of securing one of the foremost anatomists in Europe, whose texts were quoted by all the leading teachers, and whose espousal of general anatomy would have secured its place in the teaching programme of the newly established College, was lost.

Roget, too, had withdrawn his application, and so the chairs were once more rearranged: Bell was appointed Professor of Physiology and Clinical Surgery; Pattison became professor of Anatomy and Morbid Anatomy; with Bell also teaching Surgery as an interim measure; and Dr Grant was informed that the subject of Comparative Anatomy was to be added to his chair of Zoology.[163]

It is hard to see how the good intentions of the Education Committee, in establishing criteria for appointment, could have been sustained in this confusion. Bellot observed that great harm was done by the appointment of the professors before the plan upon which the school was to be organised was fully worked out[164]. It was easy to say this, with hindsight; naturally the Council would have attempted to appoint the very best men while hoping that a working plan could then be formulated. As it was, a great deal of ill-will was generated. Charles Bell put the position more bluntly . . .

> the governing body were completely ignorant of all that concerns the medical profession. The errors, in the first appointment of Medical Professors, were these: The Council did not know, or did not choose to confess, that the Medical Profession of London stood pre-eminent. They did not therefore seek their professors in London, but drew men from a distance, unknown altogether to the profession, to become teachers and masters of a school in the centre of London.[165]

The decision to appoint a demonstrator for anatomy was made in January 1828. It is remarkable that one of the candidates for this post, J R Bennett, from the Little Dean Street School, was invited, together with Bell, but not Pattison, to give an opinion on the duties of the post of demonstrator[166]. Bennett set out his proposal in writing, taking the opportunity to give a detailed view of how anatomy should be taught, and the role of general anatomy within the subject. In his letter he assumed that Anatomy was to be divided into "General Anatomy, Special or Particular Anatomy, and Medical or Surgical Anatomy . . . ". General Anatomy, he said, implied the consideration of the structure (in its technical sense) of the human body . . .

> it teaches us to distinguish the different tissues or textures which enter into the composition of the several organs, and treats of their generic character and functions. General anatomy forms the basis of the science of human organisation. It is studied in conjunction with, and as subservient to Physiology, and requires to be elucidated by constant reference to the organs and functions of the lower animals. General Anatomy also forms the groundwork of Pathology, and conjoined with it is entitled Morbid Anatomy, a subject which like Physiology requires to be treated separately and distinctly . . .

and, having described the other aspect of anatomy, he went on. . .

> This cursory view of the different modes of studying Anatomy will I hope enable you to appreciate the extent and magnitude of the subject, and suggest to you the necessity of the Professor of Anatomy being ably and efficiently assisted by a demonstrator. General Anatomy may be adequately conveyed to students in a lecture room [he had crossed out the word Theatre]. . . the demonstrator should repeat those parts of the course which require to be treated in detail . . . it becomes the duty of the Demonstrator to refresh the pupils' memory . . . he guides and assists the younger students . . .[167].

It was decided by the Committee that the demonstrator should have chief direction of the dissecting room and should prepare dissections for the professor of anatomy. Of the applicants, only Bennett and Richard Partridge were considered eligible, and, in May 1828, Bennett was offered the post.[168] Bennett's letter, stating his views, seems to have been overlooked in previous accounts of the deliberations of the Education Committee, and its existence was not mentioned in the minutes. It gave, however, a clear indication that he saw the role of demonstrator as influential, and of how, if appointed, he would expect to conduct himself. The Committee and the Council should not have been totally surprised by the subsequent turn of events.

In its second 'Statement'[169], the Council set out the plan of instruction, which included an outline of the courses of lectures. Pattison's lack of understanding of the term 'general antomy' was clear from the outset. The details of the second of Pattison's anatomy courses, under the sub-heading of 'Osteology' included the statement that

> this department will be introduced by a series of lectures on the Physiological Anatomy of the bones, or as it is called by the French *"L'Anatomie Generale"*. These will include inquiries into the Structure, Growth, and the Chemical, Physical, and Vital properties of the Bones, etc. In a word all the General facts connected with their history will be examined, and their phenomena explained. After these General Lectures . . . Descriptive Anatomy . . . and the Morbid Anatomy of the bones will form an interesting part of the Course.[170]

Each system of the body was then dealt with in a similar manner. The Course description ended with the statement that

> The Professor would beg leave to observe, that although he proposes to combine Physiological Observations with his anatomical Demonstrations, it is not his intention to enter fully into the investigation of physiological science. He will merely explain this, in so far as it is immediately connected with Anatomy, and as it tends to its illustration.[171]

Bell, in his Physiology course, also proposed to deal with each system in turn. The introductory lectures of his course would, it was indicated, consider the distinction of the membranes; reference would be made to tissues and the work of the English and French schools.[172]

The first indication of a problem between Pattison and Bell can be found in a note to Horner from Bell concerning the requirements of the Royal College of Surgeons. The Warden had asked to be informed whether the name of one or both professors would be required by the Royal College of Surgeons for students' certificates, as stated in their regulations. In his letter Bell gives his perception of the differentiation between his role and that of Pattison.

> The Council . . . have divided their General Course of Anatomy into two parts and have appointed a professor for each - the one for anatomy strictly so called who illustrates his lectures with physiological and surgical observations - The other the physiological professor who takes the more minute anatomy of this subject and carries his students into the physiological, surgical and pathological doctrines deductible from structure.[173]

It is clear that both professors considered that the general anatomy element of the course fell into their own area of responsibility, and that for both of them it formed a key part of the course. It was also apparent to Bell that, unless some clear ruling was made, the students would attend only Pattison's course, that being the one which would better prepare them for the Surgeons' examination. Bell would then be deprived of his income. He had attended a meeting of the Council in October to explain the position, but they had made no decision until The Royal College of Surgeons had been consulted.[174] The Royal College of Surgeons of Edinburgh also sent its observations on the suitability of the courses being offered. In response to these, Bell explained his views on the subject of Physiology. . . "I have formed my lectures on the demonstration of the minute Anatomy which I conceive to be the most secure foundation, and the best means of conveying information without going into vain hypotheses."[175] In November 1828, he insisted that the work, and the fees, be divided equally between himself and Pattison, and that both should sign the certificates. Bell's exasperation was evident in that he threatened to make the matter public.[176]

It is difficult to see how, in these circumstances, the students could have enjoyed a clear teaching programme. No evidence of what was actually taught has survived, other than in the references to the courses in the minutes of the Committees. It is in these minutes that, at the same time that Bell was protesting to the Council, that body was recorded as resolving to allow all students, be they those of Bell or of Pattison and, indeed, any qualified surgeon, to attend Bennett's demonstrations in the dissecting rooms[177].

It was eventually agreed that students must attend both the lectures of Bell and Pattison, but, as Bennett's popularity increased, and he began to put into practice the programme he had outlined to the Council, the rivalry and overlap of the course became more pronounced. Pattison accused Bennett of attempting to undermine his professional reputation[178], although Bennett denied that he had been teaching general anatomy . .

I have confined my labours to Descriptive or Particular Anatomy, and Medical and Surgical Anatomy, leaving to Mr Pattison the higher consideration of the science of General Anatomy.[179]

Bennett had however sought to change his status! In January 1830, he asked the Warden to convey his feelings to the Council . . .

I conceive I am entitled to a better denomination than that of demonstrator. I conceive that my having the title of Professor of Practical Anatomy would not interfere with any persons interests and would rather be beneficial to the school. I hope some definite arrangement will be made as regards me, for I am anxious to know soon what I am to expect from this institution.[180]

He also sought to enhance the status of his subject . . .

in all the great Schools, of St. Bartholomew's, Aldersgate Street, and I believe, Guy's and St. Thomas's, the demonstrations are delivered in the theatre where the lectures are given.[181]

Meanwhile, a carefully orchestrated attempt had been started, by a group of students, to discredit Pattison, and angry letters were exchanged between Bennett and Pattison[182]. Bennett defended his position . . .

The numerous other subjects which I considered as belonging to the Professor of Anatomy, I have most studiously avoided, particularly that of General Anatomy, which from its nature affords a high and attractive sphere of action, and giving the Professor an opportunity of displaying his learning and acquirements, enables him to command and win the popularity of a class . . . [183]

The events at the College had, naturally, been the subject of much comment in the press. The discontent with the work of Pattison, and the dispute between Pattison and Bennett, was widely reported[184]. Bellot observed that the scientific meaning of the quarrels was easily lost in the detail of personal animosity[185]. Perhaps Pattison himself summed up his own shortcomings when he said that . "I am complained of, I am told, because I do not teach 'French anatomy.' This is a new phrase; and I would ask, in the name of common sense, what is meant by it? "[186]

On 7th September 1830, it was agreed by the Council "with a view to promoting harmony and good feeling" that during the incumbency of Pattison and Bennett, the Anatomy courses would be divided. Pattison, as Professor of Anatomy, would teach

The descriptive Anatomy of the Bones, Ligaments, Muscles, Arteries, Veins, Lymphatics, Nerves; Their relations and connections, The Surgical Anatomy of the different regions of the Body. And the operations of Surgery.

Bennett, as "Adjunct" Professor of Anatomy would teach

The Anatomy of the developments of the Animal Structures, the Anatomy of Tissues or what is termed by the French "L'Anatomie Générale" and the Descriptive Anatomy of the viscera, and the descriptive Anatomy of the organs of the senses.[187]

So the coveted area of General Anatomy was given to Bennett and its status enhanced by its being taught by a professor.

Charles Bell, though, had not only been denied the general anatomy but also aspects of surgery. On seeing the plan for the Medical Session 1830-1831 in the medical press he resigned from all but the subject of Physiology[188], and in November 1830 he advised Horner that he would leave entirely towards the end of the session . . ."one would suppose that they [The Council] really did not know that they had already given my subjects into the hands of the anatomical professors"[189]. To add insult to injury this private letter was taken as his formal resignation which was then accepted by the Council before it was offered! Bell's long, bitter letter to Lord Auckland expressed very clearly not only his anger at the injustice to him personally but also the perception of an established London teacher, whose roots were in anatomical physiology, of the new "French" school of Anatomy and of the blurring of boundaries between the disciplines of anatomy and physiology . . .

> Another department is given to a gentleman, justly valued as a demonstrator, avowedly French in all his medical opinions, modes of teaching, and technical terms; to him has been assigned a department under the term "Anatomie Generale" . . . the Council dealt out these subjects, first to one and then to the other in the manner of a lottery, or dealing of cards, than any principle that a man of science can understand . . . in their misunderstanding of the French terms, they gave away what belonged to me as Professor of Physiology.[190]

Bell resigned in mid-session and Bennett offered to cover that part of Bell's physiology teaching that was required by the College of Surgeons and the Company of Apothecaries. The other medical professors supported this proposal and advised the Council. *The Lancet,* too, added its voice, beseeching the Council not to act with precipitancy in filling the vacant chair, saying that the errors already committed under this head should stand as a salutary caution in their future proceedings[191]. Despite advice, the Council asked Dr Southwood Smith to deliver the lectures. Southwood Smith was a teacher of forensic medicine, at the Webb Street School, who had written papers on physiological topics. He was undoubtedly known to the Council as an associate of Jeremy Bentham. A letter from Southwood Smith to Brougham indicates that decisions of this nature required the approval and support of Brougham, even though negotiations concerning the delivery of the lectures were carried out by Birkbeck.[192]

In October 1830 two prosectors, Benjamin Phillips and Richard Quain, were appointed to support the professors of Anatomy.[193] Phillips had been awarded silver medals in Bell's Physiology class and Pattison's Anatomy class, and gold medals in Bell's Surgery class and Bennett's Practical Anatomy class in the 1828-1829 session[194], and it was Phillips' answer to an examination question in Practical Anatomy that *The Lancet* had printed as a proof of Bennett's "talents and honesty".[195] Richard Quain [1800-1887] was well known to Bennett, who had been a friend of his father in Dublin. Richard Quain had come to London, where he entered the Aldersgate Street School, and worked as prosector to his brother Dr Jones Quain. The younger Quain had attended Bennett's lectures in Paris and now joined him again at University College[196].

The *University of London Calendar* for 1831 announced both Pattison and Bennett as Professors, the appellation 'adjunct' having been abandoned, and included the names of Quain and Phillips as prosectors.[197] Professor Bennett's division was described as General Anatomy, which, it was stated,

> consists in the consideration of the different substances or tissues which enter into the composition of the several organs of the body, as for example, the cellular tissue, the osseous tissue, etc. Each tissue is considered in reference to its situation in the system, its physical characters, its chemical nature, and its uses or functions, whereby a certain portion of physiology is included. The Pathology of each tissue is treated of so far as regards the physical deviations from the healthy standard which each is susceptible of, and finally the development of each tissue is given . . . General Anatomy has hitherto been rather insufficiently attended to in England, while, on the continent, its study has not only advanced most materially the particular Anatomy of man, but has further approximated Anatomy to the rank of an exact science, by making organisation generally the object of research and thereby determining the laws which regulate life, not only in the healthy, but also, the diseased condition of several organs.[198]

Bennett's lecture, "introductory to the course of General Anatomy"[199], has been described by Bellot as the first formal acknowledgement in the English schools of 'General Anatomy'.[200] This is incorrect. His source for this statement was the contemporary editorial comment headed "Recent improvements of Medical Education" in *The Quarterly Journal of Education*[201], the organ of the Society for the Diffusion of Useful Knowledge, which had been founded by Brougham. The editorial, in fact, credited Pattison, when, it said, he had suggested that the subject should be confided to his colleague. Bichat's *Anatomie Générale* first introduced the subject to the English anatomist, it reported, and added that in the more condensed view of it, given by Meckel, in the first volume of his work on Anatomy, the whole subject could be advantageously studied.[202]

Bennett began his lecture, which is the only evidence of his teaching at University College, by pointing out that if a knowledge of the diseases of internal organs was to be acquired, then the functions of the organs must first be known, in order to recognise the symptoms of disease. With this object, he said, "we must look abroad upon the wide field of animated beings, observe the common laws which govern their existence, and make organisation generally the subject of our research."[203] This most fundamental interpretation of general anatomy was the subject of his lecture. He did not mention the work of Bichat, but used that of Meckel to illustrate his discourse, which concluded with his anticipation of the development of his students' taste for higher and more extended views on the subject.[204]

The term "general anatomy" was not understood by many outside the small circle who had enjoyed the fruits of Bichat's work. *The London Medical Gazette*[205], in reporting Bennett's advancement to the role of Professor observed that the title "general" anatomy would afford a wide range for him to select the subjects of his lectures.

Bennett's lecture and the course he was about to deliver can be compared with the introductory lectures and the heads of lectures in the hospital schools and in some of the private anatomy schools at the time. Little progress can, on the face of it, be seen. The machinations of the Council of University College may appear to have hindered or at least played no significant role in the establishment of General Anatomy in their curriculum, but this is not the case. The attempt to bring new ideas and new faces onto the London anatomy scene, meant that the domination of the old school and its teaching, led by men such as Bell, was weakened; the lure of the new posts drew men away from the old established anatomy schools and contributed to the schools' decline; and, for the first time, General Anatomy was seen as a discipline to be studied in its own right, within a course of Anatomy. Efforts, too, had been made to acquire good teachers, who, Bell had hoped, would see teaching as being important, and not simply to be undertaken by a series of young and inexperienced men. He had hoped to see continuity of expertise contributing to "the uninterrupted progress of science"[206]. It is interesting to speculate how the General Anatomy course of Bennett may have developed along these lines, and what relationship his division would establish with that of Pattison. There was, though, to be no continuity. Bennett died on 27th April 1831. The report of his death in *The Quarterly Journal of Education,* stated that he had delivered but one course in General Anatomy, of which report spoke in the highest terms, when the interruptions to his health became more frequent[207]. Bennett had been ailing for some time and although this was known, his death was unexpected. He gave clear instructions that no examination of his body should take place after his death! His students, advising the Council of their intention to raise money to erect a bust of Bennett, described him as one who "has had the honour of introducing into this country a more enlarged view of the science of Anatomy than had hitherto obtained in our schools"[208].

Meanwhile, the dispute in the College over Pattison's behaviour, part of a much wider feeling of dissatisfaction engendered by the autocratic methods of the Council, escalated and ended with his dismissal in July 1831[209].

The sudden availability of professorial chairs at University College would, no doubt, have kindled the aspirations of the London medical teachers once again, and there was indeed a flurry of activity. The physiology chair, vacated by Bell, had attracted applications from a number of men including Dr Robert Edmond Grant [1793 - 1874], the professor of zoology and comparative anatomy at the College, and Mr Richard Owen [1804 - 1892], assistant conservator of the Hunterian Museum at The Royal College of Surgeons, and lecturer in comparative anatomy at St Bartholomew's Hospital school[210]. Having asked Southwood Smith to take over Bell's lectures, however, the College Council did not hurry to fill this vacancy. Just ten days after Bennett's death, in April 1831, Richard Quain, who had been asked to take over Bennett's lectures, proposed himself as a candidate for the post of Demonstrator of Anatomy[211], this having been the post to which Bennett was originally appointed, and the arrangement between Pattison and Bennett having been a temporary one. He pointed out that he had taken over and completed Bennett's course and reminded the Council of his experience as a demonstrator in Paris and in a private school of Medicine. Frederic Carpenter Skey [1797 - 1872] was also a candidate for the post[212]. Skey had been a demonstrator at St Bartholomew's Hospital School, under Abernethy. At the time of Bennett's death, Skey was in dispute with Lawrence, Abernethy's successor, and resigned his post, later becoming one of the key teachers at the revived Aldersgate School[213].

It was from Aldersgate Street that Dr Jones Quain, brother of Richard Quain, and the author of *The Elements of Anatomy*[214], then in its second edition, also sought to move to University College, where he was undoubtedly already known to the medical professors. His first act was to write to William Coyningham, Baron Plunket, whom he had known in Dublin, saying that the medical department "have expressed themselves decidedly favourable to my application . . . but the appointment does not rest with them, it is invested in the Council of which Lord Brougham is a leading member." He then asked for an introduction to Brougham.[215] Lord Plunket wrote to Brougham telling him that he owed Quain an obligation for old services in Dublin College.[216] Quain did not wait for the post to be advertised, but sent a long and eloquent letter of application to the Council[217]. He pointed out his accomplishments and the fact that since Tyrrell had been appointed professor of Anatomy at St Thomas's, he, Quain, had had sole responsibility for lecturing on Anatomy and Physiology at the Aldersgate Street School. He accompanied his letter with an impressive list of referees. The medical professors delivered a testimonial to the Council, in which they expressed unanimous support for Quain as Professor of Anatomy, citing his character, his literary and professional attainments and his popularity as a teacher. At the same time they recommended his brother, Richard Quain, as Demonstrator[218]. The Education Committee had recommended that the usual advertisements be suspended and the Council rescinded the two weeks notice of appointment for the posts[219]. At the meeting of August 8th, Jones and Richard Quain were confirmed in their posts by the Council[220]. Two members, though, Warburton and Weymouth, proposed in an amendment that the post of Professor be advertised, but this was defeated and the appointment went ahead.

Mazumdar has suggested that the withering away of the approach to physiology taught in the private anatomy schools, where it was, she maintained, used as a means of explaining human anatomy, was a side effect of the reform of medical education.[221] To support this suggestion she indicated that Jones Quain had a rival for the post of Professor of Anatomy, namely Richard Grainger, of the Webb Street School, one of those she termed the 'physiological anatomists'. She contrasted the two men, showing Quain to be one who would, in the eyes of the appointments committee, raise the status of the medical teaching in the College, being, she said, a gentleman with a gentleman's point of view, while Grainger, then a man of considerable reputation, and teaching one of the largest anatomy and physiology classes in London, lacked such an attribute.[222] No doubt her assessment of both Quain and Grainger was accurate, but her suggestion, since quoted by at least one other[223], that there were two applicants for the post and that their merits were considered by an appointment committee, is incorrect. The suggestion that Grainger's merits were discussed by the Council in 1831 is to be found in a confidential note to its secretary written in 1836, when, once again, the post of Professor of Anatomy and Physiology became vacant.[see page 81 below] In 1831, the Council actually proceeded without an advertisement, and, just over two weeks after Pattison had been removed from his post, Quain was appointed in his stead.

The Education Committee recommended that physiology should also be taught by Jones Quain and this was agreed[224]. Southwood Smith received a letter which said that "The Council have determined on uniting Physiology with Anatomy and have confided both subjects to Dr Quain . . . "[225], while the other applicants were told that the Council did not intend to establish a separate chair in physiology that year[226]. The appointment of Quain received only a muted response from the medical press. *The Lancet* reported the Education Committee's recommendation with the comment that, judging from precedents, this would be tantamount to the confirmed choice of these gentlemen[227]. The merger of the two chairs earned a critical comment in *The Quarterly Journal of Education* . .

> We cannot but observe with regret, that the three departments of General Anatomy, Descriptive Anatomy and Physiology, are all comprehended in the duties of one teacher. This is a bad custom of the worst schools of the old time. Physiology has been too long made a minor branch of the anatomical teacher's department. Even more important than anatomy, or at least demanding, in the present state of both sciences, more original investigation, it is quite impossible that it can be efficiently taught by any one who has the additional labour of preparing and delivering a daily lecture in anatomy . . . The teaching of anatomy, even by itself, has of late years become an undertaking of no trifling nature. Whilst *descriptive* anatomy has become infinitely more minute, what is called *general* anatomy has been, it may almost be said, created as an addition to it . . . The student . . . looks for the philosophy of anatomy . . . he requires a knowledge of the organic elements of the simple textures or tissues into which the solids are divisible. He seeks for large and general views of the properties and characteristics of *all* the constituents of the body . . . this must lead to new arrangements among the teachers.[228]

It is interesting to see that here, in 1831, general anatomy was acknowledged as a specific facet of the teaching of anatomy, requiring not only time, but also expertise, to meet the new demands; and that there was a recognition that patterns of teaching would have to change.

King's College

The comings and goings in the Medical Department in University College would have been keenly observed by a similar group of men in The Strand. Here, in 1828, King's College had been founded, in direct contrast to University College, as a College for General Education, where . . . "it shall be an essential part of the system to imbue the minds of youth with a knowledge of the doctrines and duties of Christianity, as inculcated by the United Church of England and Ireland . . .The professors will be appointed by the Council, and must all be members of the Church of England . . ."[229].

The Council appointed a group of advisers to recommend those professorships they considered necessary in the Medical Department, which was to be considered first. The group were three members of the Council of the new College : Sir Henry Halford of the Middlesex Hospital, President of The Royal College of Physicians; Sir Astley Cooper of Guy's, who had been, in the previous year president of the Royal College of Surgeons, and was Surgeon to the King; Mr (later Sir) Benjamin Brodie of St George's Hospital, Lecturer in Comparative Anatomy and Physiology at The Royal College of Surgeons and Sergeant-Surgeon to the Queen; all establishment figures who represented the Medical Corporations of London. In March 1830, they recommended that there should be a Professor of Anatomy and Physiology, assisted by a demonstrator.[230] The posts were advertised in the "leading newspapers"[231]. There is only one reference in the minute books of an application[232], that of George Pilcher, who lectured on anatomy, physiology and surgery at the Webb Street School, owned by his brother in law, Richard Grainger. There is, unfortunately, no other record in the archives of the applicants for the posts, of the criteria used in selection, or of the discussion.

In July 1830, the advisers nominated Herbert Mayo FRS, as Professor of Anatomy and Physiology and Richard Partridge as Demonstrator.[233] Both men had been unsuccessful in similar applications at University College, but the stalwarts of the great medical corporations had no qualms about appointing London men to King's College. *The Lancet*, in giving an account of the opportunities available for medical students for the session 1831-1832, reported the new chairs at University College and observed that it now presented, probably, the most powerful medical school in the metropolis. University College and King's College stood, it felt, in complete contrast, - the medical department of the one celebrated for its strength, the medical department of the other ludicrous for its weakness. Such condemnation was typical of the radical journal, and unfair to both Mayo and Partridge.

At the time of his appointment Mayo was surgeon to the Middlesex Hospital and lecturer on anatomy at the Great Windmill Street School; his teaching there having provided the framework for his text *Outlines of Physiology*[234], then in its second edition. Mayo was also lecturer in anatomy and surgery at the Royal College of Surgeons. There have been various views on his success as a teacher. His biographer[235] observes that "as a teacher he was admirable, bringing forward the leading facts and doctrines without superfluous detail, and illustrating them with impromptu drawings on the blackboard . . . he had a great power of attaching the students to him." His obiturist in *The Lancet*[236] claimed that "his lectures on Anatomy and Physiology were remarkable for their beauty and style", but Hernshawe, in his Centenary History[237], condemns Mayo as being a good anatomist but not a good teacher; and goes on to attribute to him and to other inadequate professors, the decline of the Medical School at King's in 1835-6.

The content, if not the quality, of Mayo's teaching at King's College can be judged from the College *Calendar*[238] and from his introductory lecture which, on this occasion, was published. In this lecture, using the bones to illustrate his pattern of teaching, he indicated that, after the nature of the bones had been explained in their general anatomy and morbid anatomy, the skeleton would be demonstrated[239]. In the *Calendar*, his lectures were described as being on "Anatomy, Physiology and Pathological Anatomy". Their description indicates that he included any general anatomy he taught as an integral part of the course . . . "associated with these studies [of Anatomy] is the Science of Physiology, or the doctrine of the uses of parts, and of the laws and endowments of the elementary textures of the frame."[240] It was in Partridge's practical classes, however, that the subject appears to have been spelt out further . . . "this division will embrace those branches of Anatomy which are comprehended under the terms of *Descriptive* or Systematic Anatomy; *General* or Structural Anatomy; *Surgical*, or the Anatomy of Relative Situation."[241]

Richard Partridge [1805 - 1873] had been a student of Abernethy at St Bartholomew's and then became Demonstrator of Anatomy at the Great Windmill Street School, and so was well used to working with Mayo. Partridge was said to be an excellent lecturer, and an admirable blackboard draughtsman.[242] In a move which was an interesting parallel to that made at University College, Partridge was elevated from the position of demonstrator to that of professor. In August 1833, the Council had been advised by the medical professors that it would be . . ."expedient to appoint Mr Partridge, Professor and Demonstrator of Practical Anatomy, it being intended that this alteration in title shall not make any alteration in the duties which he is to perform."[243] At the beginning of the next medical session, in October, the Council ... "taking into consideration the importance of the duties devolving upon the Demonstrator of Anatomy, and the able manner in which Mr Partridge, the present demonstrator has performed them, resolved that Mr Partridge be appointed Junior Professor in Anatomy, but that such appointment shall not be considered as making any alteration in his duties, which he has hitherto performed."[244] What lay behind this promotion, whether it was dissatisfaction with Mayo, a desire to enhance the importance of practical anatomy, or whether it was seen as a means of retaining the services of a very competent man, is not clear, as no discussion is recorded in the minutes.

The Hospital Schools

The courses and tutors for the 1833 - 1834 London Medical Session were set out, with editorial comment, in *The Lancet*[245]. Five of the major hospitals had medical schools attached to them; The London, St Thomas's, Guy's, St Bartholomew's and St George's; while the Westminster and the Middlesex had a number of anatomy schools nearby. University College was reported as having its hospital built. The fees for the study of anatomy and dissections in both the hospital schools and the unattached schools were tabulated, and the conclusion reached that . . ."the fee for hearing lectures on anatomy, and possessing conveniences for dissecting *within* the hospital walls, is, in all instances, twenty guineas, to "perpetual" pupils, while *without*, the fee is only ten."[246].

Students at the London Hospital had no option but to attend the lectures of Messrs Luke, Hamilton, and Adams, there being no other school or dissecting theatre near the hospital. It is known that the medical practitioners teaching at the London formed themselves into an association of "Lecturers on and Teachers of Medicine, Surgery, and Anatomy and other sciences connected therewith at the Theatre attached to the London Hospital" in 1831. The only records of this association prior to 1846, are a few references in a notebook of Luke[247]. James Luke [1799 - 1881] had attended the lectures of

Abernethy and had been appointed demonstrator of anatomy at the London Hospital in 1821, had become lecturer in anatomy in 1822 and in surgery in 1823. He had been appointed assistant surgeon in 1827 and became surgeon in 1833, and was to be elected FRS in 1855[248]. Alfred Hamilton [d. 1884] was an assistant surgeon in 1831, and became full surgeon in 1845[249]. John Adams [1805-1877] was appointed demonstrator in anatomy in 1828, became lecturer on anatomy and later on anatomy and surgery. Adams was an assistant surgeon for nineteen years before becoming a full surgeon. He was said to be a popular teacher, firm but genial, given to bringing quiet to his class by thumping on the table and shouting "If you don't stop this bloody row I will close the lecture"[250]. There is no evidence in the London Hospital archives, of what, if any, general anatomy was taught during this period.

Guy's and St Thomas's had worked together between 1725 and 1825, as the "United" or "Borough" Hospitals, and the teaching had been shared. Guy's teaching was largely in medicine, with surgery and anatomy being taught at St Thomas's[251]. Grainger's Webb Street School had, too, for a long time been intimately associated with the Borough hospitals. When the two schools separated, following disputes between governors and lecturers, that at Guy's prospered, while the school at St Thomas's began to decline[252]. The report of the Grand Committee of St Thomas's, which considered this decline, blamed the establishment of new medical schools, and their own medical officers, for having not only withdrawn from St Thomas's, but, while serving at St Thomas's, engaged themselves as lecturers in other institutions.[253] *The Lancet* gave scant attention to the anatomy teaching in either of these schools, namely that of Bransby Cooper at Guy's and of Mackmurdo and Solly at St Thomas's. Samuel Solly [1805-1871] went on to lecture on anatomy and physiology until 1839. He was reported to be a florid lecturer but a good technical teacher. He later became surgeon and lecturer on surgery in succession to Joseph Henry Green, and was elected FRS in 1836[254]. It was from Solly that Richard Grainger was to take over in 1841. At Guy's "a distinct course of lectures on *Physiology*" was delivered by Dr Blundell, who, in 1825, had published *Researches, Physiological and Pathological*, a work containing his original investigations on ovariotomy and blood transfusion[255]. Blundell's expertise was essentially in midwifery, and his physiology involved no general anatomy. When he left Guy's in 1834, the teaching of physiology, as a distinct discipline left with him[256]. The Webb Street School, however, where Grainger and Pilcher lectured, with Millard as demonstrator, was acclaimed as being " not excelled by any medical school except that of the London University" [257].

Edward Stanley [1793-1862] had been appointed lecturer on anatomy and physiology, in place of Abernethy, at St Bartholomew's. He had been elected FRS in 1830 for his pathological work but was not a distinguished lecturer[258]. In this area of London, it was at the Aldersgate Street School that the good teaching was taking place. As *The Lancet* remarked, it would "this season greatly diminish the number of entrances to the lectures on anatomy and dissections at the hospital."[259]. Quain's successor at the school was Robert Todd, who, with Skey and J H Walsh lectured in anatomy and physiology.

Robert Bentley Todd [1809-1860] was born in Dublin, the son of a well known surgeon. He had entered Trinity College, Dublin, with the intention of studying law, but, on his father's death in 1826, had turned to the study of medicine. Robert Graves, who became professor of physiology at Trinity College, was one of his teachers, and had a great influence on Todd, giving him the taste for physiological enquiry.[260] Todd graduated BA in 1829, and in 1831 became a licentiate of the Royal College of Surgeons of Ireland. In the summer of that year he went to London and obtained a post as lecturer on anatomy at the Aldersgate Street School, where he stayed for three sessions[261]. In his introductory address delivered at the opening of the medical session of 1832[262], he set out clearly his approach to the study of human anatomy... "The anatomy of man is to be considered ... as it unfolds the minute structure and mechanical disposition of the different parts of the body; here our object is directed to discover the adaptation of organic structure to the performance of function ... a minute acquaintance with pathological or morbid anatomy is no less essential ..." His message was that both surgical and medical students needed to become familiar with the minute anatomy of the body in health andthen in disease. Todd used the term 'minute anatomy' in this introductory lecture, but in his *Cyclopædia of Anatomy and Physiology*[263] [see page 75 below] he headed the descriptions of the anatomy of the various tissues 'Anatomy, General or Physiological'. Todd had also, in a letter to the editor of *The London Medical Gazette,* made a case for extending the time spent on anatomy courses[264]. In his letter he pointed out that the courses in the English schools were of only three months duration, whereas in Scotland, Ireland and on the Continent they were of six months. He felt that this forced teachers to deal with important aspects of anatomy in a superficial manner, and . . .

> "induces the additional evil of leading the student to attach but a minor degree of importance to minute anatomical investigations. Such a minute knowledge, he thinks, he never will have occasion for in practice, and unless he has reason to expect that he will be called on to exhibit it at an examination for his diploma, he sees no benefit likely to result from it."

Not all the hospital schools taught anatomy, however. Pupils at the Middlesex, the Westminster, and at St George's were obliged to attend lectures at one of the private schools in the vicinity of the hospital. In some cases a special relationship existed between a hospital and a nearby school, such as that between St George's and the 'Theatre of Anatomy' in Grosvenor Place, belonging to Samuel Lane. Whereas the lectures at Lane's were well spoken of[265], this was not necessarily the case in all of them. *The Lancet* referred to the re-opened Brookes's Theatre with a characteristic sneer . . . "this "school" is announced to be reopened by Mr King and Mr Malyn . . . the *name* of the school at least is celebrated . . ."[266]. That the teachers here, both of whom had unsuccessfully applied for posts at University College, had failed to keep up with the scientific literature is clear from King's introductory lecture of October 1833[267]. In this he introduced general anatomy as . . . "embracing the materials and sets of organs, more especially in reference to everything they present generally"[268] and described the "globules" of which the tissues are composed[269].

The Role of Pathological Anatomy.

Almost without exception, the introductory lectures in anatomy and physiology in the London schools, whether attached to a hospital or not, emphasised the importance of the study of the general anatomy of the tissues in both health and disease. In the same issue of *The Lancet* which reviewed those courses available to the student in London in 1833-4, the editor drew the attention of his readers to a course at University College which was not taught at other establishments, that on morbid anatomy by Professor Carswell. Although, he pointed out, many London lecturers professed to teach pathological anatomy in connection with a full course of lectures on anatomy and physiology, in the French schools, and more recently in Edinburgh, a separate course was offered. He recommended Carswell's course, remarking that it did not appear "to be entitled to the notice of the rulers in our chartered Colleges and Halls"[270].

The views expressed in *The Lancet* were not necessarily echoed by all in the medical profession. In a lecture to the Medical Society of London in 1830, entitled 'Modern Medicine influenced by Morbid Anatomy' its vice-president declared that . .

> I am inclined . . .to question whether this analytical method of investigation be in reality the true road to the due appreciation of many diseases. Analysis may be carried too far, at least for pathological uses. In systems of general anatomy, we see it trace all the tissues to one or two primary elements; so simple that they cease to represent the modified structure of the organs which are variously constructed from these fundamental materials."[271]

This was not an unreasonable comment; Grainger's *Elements of General Anatomy*[272] and Craigie's *General and Pathological Anatomy*[273] had been published only the year before and would have presented a new, and, to many practitioners, no doubt, a daunting approach, to the study of morbid anatomy.

The Lancet, however, in keeping with its radical views, recommended Carswell's course, on, it said, a subject which had of late years been prosecuted with peculiar assiduity on the Continent. The editor, in maintaining that Carswell's was the only course of its kind being offered, had failed to check the pages of his own journal, though, since in that issue, Guy's hospital also announced lectures on morbid anatomy, to be given by Dr Hodgkin.[274]

The Edinburgh course referred to in *The Lancet* was that given by John Thomson, first holder of the chair of pathology at the University of Edinburgh. Both Jacyna[275] and Maulitz[276] have remarked on Thomson's pivotal role in encouraging Edinburgh students to pursue further studies in France. These students included his sons William and Allen Thomson and Robert Carswell.

Robert Carswell [1793 - 1857] went to France to collect pathological data and, above all, illustrations to be used in John Thomson's teaching in Edinburgh. Jacyna gives a detailed account of his stay at the Hôtel-Dieu in Lyons.[277] Carswell had studied medicine at the University of Glasgow and had distinguished himself by his skill in drawing. It was in 1822 that he first went to France for Thomson, before returning to take his degree of MD at Aberdeen in 1826[278]. He returned to France to continue his study of morbid anatomy and from there, on 18th April 1828, was appointed to the post of Professor of Pathological Anatomy at University College, London, after it became clear that Professor Meckel would not accept the chair[279]. The resolution by the Council of University College to appoint Carswell also encompassed the purchase of his collection of illustrations of morbid anatomy, and the agreement that he would remain in France to complete its production.[280] Carswell's biographer in the *Dictionary of National Biography* describes his illustrations as having . . . "for artistic merit and for fidelity, never been surpassed, while the matter represents the highest point which the science of morbid anatomy had reached before the introduction of the microscope."

Thomas Hodgkin was, with Carswell, one of the group of British students who sought to enrich their medical education in France in the 1820s, but there is no evidence to suggest that they were acquainted while they were in Paris. Hodgkin had returned to England in 1825 and had been appointed Inspector of the Dead and curator of the anatomy museum at Guy's Hospital, at the time that it was developing its medical school following the separation from St. Thomas's[281]. At Guy's, Hodgkin had the advantage of having as colleagues, Richard Bright [1789-1858] and Thomas Addison [1793-1860], all three being Edinburgh graduates who shared the new scientific approach to medicine, correlating post-mortem observations with symptoms of disease before death. It might have been supposed that, when Hodgkin was invited to address the Physical Society at Guy's hospital at its first meeting of the

1827-1828 session, he would have chosen to discuss some aspect of morbid anatomy. Instead, however he read "An Essay on Medical Education", which was published in the following year.[282] In this essay he suggested that for many, apprenticeship was a waste of time and encouraged bad habits in both diagnosis and treatment. He put forward an alternative plan, with which, aided by "hints which may usefully be borrowed from some Foreign schools", the objects of medical education could best be achieved.[283] He designated anatomy as the first and most important subject, and, having acknowledged that at Guy's descriptive anatomy was well taught, he observed that . . .

> General anatomy, or the anatomy of tissues, however, by a sort of common consent, is, to a great degree, neglected. It is far otherwise in France, where this subject, if it did not originate, at least acquired a new and particular importance, through the labours of the great Bichat. The late lamented Béclard devoted to it a considerable portion of his course; and the crowd of pupils, whom I was daily in the habit of meeting, amply attested the interest and importance attached to it.[284]

He suggested that general anatomy could feature more fully in the second course of the session, without harming the special anatomy course. In the student's second year, he went on, it would be proper and necessary for internal pathology to be studied. He recommended that this be taught in conjunction with the theory and practice of physic so that the two could be correlated.[285] He concluded his essay by attributing the comparative indifference to morbid anatomy, to the fact that students were placed in medical practice before they had become acquainted with healthy structure and were therefore incompetent to judge the endless variations induced by disease. His lecture generated considerable debate, both after the meeting and in the medical press, not so much for his comments on the teaching of general anatomy, but because of the implied criticism of the arrangements of the licensing bodies, at a time when the new medical colleges were opening and the radical press was agitating for reform. The report in *The Lancet* did not miss the opportunity to record the comment on the College of Surgeons and the Society of Apothecaries by Mr Lambert of Guy's . . . "contrast their paltry, ineffective regulations, with those established in France, and their trivial examinations also"[286]. Other listeners disagreed with Hodgkin on the amount of time which should be spent on teaching the anatomy of the tissues. Dr Whiting, physician at the Surrey Dispensary, for example, thought that it was an unnecessary expenditure of the students' limited time to learn minute anatomy.[287] Kass and Bartlett, in their annotated bibliography, and Kass and Kass in their biography of Hodgkin, have, in condensing the substance of this essay, suggested that he himself used the word 'histology'.[288] In fact, Hodgkin used only the terms 'general anatomy' or 'minute structure', both in his lectures and in his paper, written with J J Lister[289], which described the microscopical appearance of blood and animal tissues.

Hodgkin's lectures on morbid anatomy began in the 1827 session at Guy's Hospital; his was the first systematic course to be taught in Britain, the subject having been, until then, included in lectures on anatomy, surgery or medicine. The lectures were later published in two volumes entitled *Lectures on the Morbid Anatomy of the Serous and Mucous Membranes*[290]. Despite the title, the volumes are, in fact a detailed treatise on morbid anatomy. In the preface to the volume, published in 1836, Hodgkin acknowledged his debt to the teaching of Laennec and Rostan in Paris, and to the skills of Andral, in conducting inspections of the dead. He explained that it had been one of his objects . . . "to investigate morbid appearances in relation to each other, and with reference to the commencement, progress, and ultimate results of particular modes of derangement." Such a course, he said, could only be taken with the help of general anatomy, "in seeking to become acquainted with the changes of particular structures, and in analysing the derangements of those organs which possessed a compound structure."[291] In his introductory lecture he bemoaned what he saw as " the almost total neglect of general anatomy, or that division of the subject which teaches the peculiarities of structure in the healthy state, and which is consequently most intimately connected with pathological anatomy"[292]. When discussing morbid anatomy as an aid to the study of physiology, the operations of living animal chemistry, as he termed it, he described his excitement at seeing a living zoophyte in the field of Lister's microscope. With great insight, he suggested that such demonstrations would probably lead to curious and important discoveries, but that at that stage morbid anatomy offered the chief assistance in investigations. He put forward the view that in no branch of medical knowledge had greater advances been made in the previous few years than in morbid anatomy. He attributed this to . . . "the specific cultivation of *General Anatomy*, the outlines of which were faintly sketched by Carmichael Smith." The highest praise though he reserved for Bichat, who, he said . . . "while he seems to have possessed the merit of originality equally with Dr Smith, has pursued the subject into its minutest details; so as to leave little to his successors, but the introduction of a few modifications and divisions." He drew Bichat's lectures on *Morbid Anatomy* to the attention of his readers, emphasising that these later lectures of Bichat were based on his earlier *General Anatomy.*[293] He had, he said, decided that the best arrangement for a course of morbid anatomy, was that founded on general anatomy. Only, he felt, by collecting into one view the various alterations which disease effected in any particular tissue, could one hope to arrive at an accurate knowledge of the relation which these modifications bore to each other, and to the healthy state. Instead of dividing the body into regions, therefore, he proposed to examine certain pervading tissues, which presented the same characteristics throughout the entire organism. Even though other teachers at that time were advocating the importance of general anatomy, Hodgkin's clear statement here was the most powerful rationale for its inclusion in the medical curriculum that had been made in England at that time.

In his lecture on serous membranes he denied the existence of globules as structural components of the tissues; these, he said, being merely an optical illusion. He recounted . . .

> My friend Joseph Lister, who has carried the powers of the microscope far beyond anything to which they had previously attained, has very minutely examined this [cellular tissue], as well as most of the other animal tissues. He and myself have spent hours in the most careful examination of the subject, and not the smallest doubt is left on our minds as to the absolute fallacy of the globular theory."[294]

There was a four year interval between the publication of the first and second volumes of Hodgkin's work. This was due partly to illness and partly to the fact that Hodgkin left Guy's in 1837 [see page 162 below]. The difficulty he faced due to loss of access to his specimens, occasioned by his departure from Guy's, gives some insight into his teaching methods. He illustrated his lectures with preparations from the museum which he had built up and catalogued. In the second volume he explained that, following his "unexpected separation", he was deprived of the materials on which he relied for consultation in the completion of the work . . . "I had been accustomed to depend on the preparations as texts . . . "[295]. The final part of the work was never published. The Catalogue[296] of preparations in the anatomical museum at Guy's had been published in 1829, and was, like the course of lectures arranged around it, based on a classification derived from Bichat's general anatomy. The list of specimens of muscle, including some injected preparations, was accompanied by a detailed description of muscle tissue, as seen with Lister's achromatic compound microscope. Any approaches, Hodgkin wrote, towards a more accurate knowledge of the intimate structure of organised beings, may reasonably be looked to as collateral aids to our acquaintance with the influence of physical agents on life.[297]

Rosenfeld's excellent biography of Hodgkin[298] included an appraisal of the success of Hodgkin's treatise. He pointed out that the book did not have a wide circulation, because of the delay between the publication of the first and second volumes, and because it was never completed. Another factor, he suggested, although there is no evidence for this view, was the popularity of Baillie's book on morbid anatomy[299], which was accompanied by an atlas of engravings; Hodgkin's book had no illustrations. Baillie's was the first textbook of pathology in the English language, and in it he arranged the organs of the body systematically and described the morbid conditions of each. This was a new approach, in contrast to older treatises which described diseases at great length. Baillie made his observations from the specimens in the anatomical museum of his uncle, William Hunter. Rosenfeld records that Hodgkin published his own book because he felt that Baillie's paid comparatively little attention to general anatomy and lacked "that minuteness of detail which is essential to a work destined to teach pathological anatomy."[300]

The emphasis on morbid anatomy and the correlation of post-mortem findings with the symptoms of disease before death had, by this time, become a familiar feature of the introductory lectures in the medical schools. There was also an attempt to classify diseases using general anatomy as a basis. The lecture by Wardrop at the Aldersgate Street School[301], delivered at the same time that Hodgkin began to lecture at Guy's, attempted to show the effect of Bichat's arrangement in forming a pathological or nosological system.

It would be a mistake to think that because Hodgkin, and other authors such as Mayo, described the results of their investigations with a microscope, that by 1836 the improved compound instrument was commonplace in London, and that the results of its use were always meaningful. A good example is provided by Hodgkin himself[303]. In the first volume of his *Lectures* he records the first description of *Trichina spiralis* by Richard Owen. Hodgkin explained how his friend and former assistant, H Peacock, had, in 1828, made a dry preparation of muscle to demonstrate the cysts, and that J Hilton drew up an account of its occurrence, having seen several examples in the dissecting room. J J Lister had also examined the cysts, but the enclosed worm had remained undiscovered, either because the specimen was "too decomposed or otherwise unfavourable to the examination". Hilton had prepared an illustrated paper on his observations and had read it before the Medical and Chirurgical Society, but its publication had been, Hodgkin said, suppressed by the Council. Some time later Owen and Dr F J Farre had, he reported, seen the same condition at St Bartholomew's, and Owen had described it. A personal account of the discovery was given by James Paget, some years later.[304] He recounted the dissection of a man who had died in the hospital of St Bartholomew's in 1835:

> "Examining some of these 'spiculae' with a lens, I soon found they were cysts . . . I was anxious to observe them with a microscope, and, possessing none, I applied to the only man of science whom I at that time knew in London, Mr Children, principal keeper of the Natural History collection at the British Museum. He, I think, had no microscope, and he therefore took me to Mr Robert Brown . . . Mr Brown at once lent me his simple dissecting microscope, with which I soon observed structures in the worm which were before invisible. . . portions of muscles were distributed far and wide, and among those to whom they were first carried was Mr Owen."

It is clear that useful microscopes were few and far between in the early 1830s. The prominent place given to microscopic observations in Hodgkin's papers and lectures was not because they were part of his usual practice, but because his observations using Lister's instrument had revealed such remarkable detail in the structure of the tissues.

Morbid anatomy and minute anatomy had, however, been linked before Hodgkin and others of his generation brought back a tissue-based system of pathological anatomy from France. Maulitz has recounted how John Richard Farre [1775 - 1862] had created a surgical pathology in the 1820s. This, he pointed out, was infused with tissue and with inflammation theory, and focused on the ophthalmic and cardiovascular systems and their interrelations.[305] In 1828 Farre tried to set up an Academy of Minute Anatomy as an offshoot of the London Ophthalmic Infirmary. Both Tyrrell and Lawrence were colleagues of Farre at the Infirmary, and they had, as early as 1822, proposed an ambitious programme of lectures there. It is Maulitz's view that the venture was ultimately a casualty of Thomas Wakley's reforming zeal[306]. Both Tyrrell and Lawrence moved into mainstream hospital practice, but Farre continued with his plans. In 1828 he brought out the first and only volume of his new *Journal of Morbid Anatomy*.[307] The tone of the review of the journal in the *London Medical Gazette*[308] perhaps explains its rapid demise . . .

> no kind of arrangement seems to have been attempted . . . the profession would receive the result of Dr Farre's practical experience and pathological investigations with gratitude: but even his name will not serve as a passport to the extraordinary medley with which he has presented us on this occasion.

Rolleston[309] regarded Farre as being much in advance of his time as regards morbid anatomy, while Maulitz sees his role and that of the Academy of Minute Anatomy as a link and as a means of reviewing both the science of anatomy and the anatomy of science between the times of Hunter and Hodgkin[310]

Hodgkin and Lister's work with the microscope, however, certainly influenced those authors whose texts were being recommended by the teachers of anatomy in London. Grainger referred to it in his text of 1829, and Bostock, Mayo and Quain each quoted it in the later editions of their works.

Todd's *Cyclopædia.*

Bostock, Grainger, and other well known men, including Milne Edwards, Craigie, Kiernan, Owen and Partridge, but not, remarkably, Mayo, also contributed to Todd's *Cyclopædia*, the first part of which was published in 1835.[311] At that time it had been calculated that twenty parts would complete the book and that it could be done in a relatively short time. Not only did the whole enterprise become greatly enlarged, but, for a variety of reasons the publication was delayed, so that the final volume of the work was not published until 1859. In the preface [written in 1859] Todd explained that he had tried . . . "to secure the assistance of contributors who would be likely to make original investigations, and to employ new researches for furnishing the of their *matériel* of their articles." He pointed out that the work had needed to be enlarged because of the rapid strides which the knowledge of many subjects in anatomy and physiology had begun to take at the time when the earlier parts of the Cyclopædia were being prepared. Minute anatomy, he said, which thirty years previously [in 1829] had been crude and undigested, now took very high rank among the various branches of natural knowledge. During the intervening years every tissue had been scrutinised, many obscure points had been cleared up, and much that was unknown had been brought to light. Todd also recorded his regret at the tardiness in the completion of the Cyclopædia, but explained that after the publication of the first two or three parts of the work . . ."certain onerous duties devolved upon him . . . he was called upon at short notice to deliver a lengthened course of Lectures on Anatomy and Physiology of a kind quite new in this country, both as regards extent and nature, which demanded a large amount of study and of personal enquiry and investigation . . ."[312]

Part II[313] of the *Cyclopædia* was published in August 1835, and announced Robert Todd as Professor of Physiology and of General and Morbid Anatomy in King's College, London. The list of contributors included the name of Richard Partridge, described as Professor of Descriptive and Surgical

Anatomy in King's College and that of William Sharpey, described as Professor of Anatomy and Physiology in University College, London. This quite dramatic change in the occupants of the chairs at the two colleges was brought about by the resignation of Jones Quain, and was to have a very significant effect on the teaching of general anatomy in those establishments.

Sharpey's Appointment at University College.

Jones Quain resigned his chair at University College on 16th June 1836.[314] Some light is shed upon his decision in a letter, dated 26th June, from Dr Turner, then Dean of the Medical faculty, to Mr Atkinson, the secretary to the Council.[315] In his letter Turner recounts that . . .

> he, [Quain] long ago told me that he dislikes the restraint of his duties . . . his health is delicate, especially his lungs, and he sometimes feels severely the labour of lecturing . . . he at times, in consequence, fails to keep alive the interest of his class and the audience falls off. The result is the students have gradually been led to attach a higher value to the teaching of Mr Quain than to that of the Doctor . . . .

The Quain brothers, he said, never got on well with each other . . .

> the mere fact of Mr Quain's expressing an opinion in the faculty or senate is enough to make the doctor angry and has often done so. He seems to underestimate whatever his brother does . . . some years ago at the distribution of prizes, Mr Q was addressing the Chairman with great ability and effect, and I was sitting between the Brothers. What think you the doctor was about during his brother's address? - Repeating in an undertone, but so loud that his brother and I heard him, *damned nonsense, damned nonsense, damned nonsense*. This had nearly interrupted Mr Q altogether, and of course exasperated him highly.

The purpose of Turner's letter was to try to prevent the Council from being misled by Dr Quain concerning his brother's claims on the "score of his merits" to the chair of Anatomy. It is not difficult to interpret Turner's aspirations concerning the younger Quain. He went on to reveal that Richard Quain had suggested that, in the circumstances, the Council should place the whole anatomical department under two persons, who should be joint Professors of Physiology, Anatomy and Practical Anatomy. Turner was anxious that there should be no competition for the posts . . .

> advertising will be worse than useless. By advertising we should bring forward a host of small men, all thinking themselves very clever, all probably to be set aside for someone who would be elected by invitation . . . we can take no man who is not fully before the public, no one who has not an established fame and experience in teaching

> anatomy. Our search is limited to actual teachers in London, Dublin and Edinburgh, and the character of these can easily be known."

The potential candidates were then discussed. Turner revealed that, when Jones Quain was appointed, the Council had decided that the only other possible contender was Richard Grainger, but that Quain had been preferred on account of his regular academic education. On this occasion Turner felt that, once again, Grainger was the only London teacher worth considering. In Dublin, he said, Richard Quain knew of no suitable person, but in Edinburgh . . . "there is one man, a Dr Sharpey, of whom I have heard a high character . . .I find that Mr Q also entertains a high opinion of Dr Sharpey." Richard Quain had offered to visit Edinburgh "and learn by personal examination if Dr S will suit us". Turner recommended that if Sharpey should prove to be satisfactory then the anatomical school should be reorganised before the end of July. Should, he said, Dr Sharpey prove a worthy adjunct to Mr Quain, the anatomical school would be perfect and far stronger than it had ever been. In the event of Sharpey being considered equal to Grainger, then Sharpey would be preferable, for the same reasons which had made them prefer Quain. A second letter from Turner[316], sent five days later, concerning the remuneration of the professors, also reported that Carswell thought highly of Sharpey.

Turner's letter to Atkinson had followed a meeting of the Senate at University College[317], which had been convened to consider the minutes of a meeting of the Faculty of Medicine, proposing a plan following Jones Quain's resignation. The faculty had unanimously agreed that two professors of equal rank be appointed. One of these should be Richard Quain, who would teach descriptive and practical anatomy. The other would teach "General or structural anatomy and physiology. It will consist of a complete account of the Anatomy of Textures, development of Organs and Physiology more complete and extensive than formerly . . . " There was an attempt by some members of the Senate to spend more time in discussing these proposals, but this was overruled.

The Council, however, steered a safe middle course, and, having decided to advertise the chair as that of Anatomy and Physiology[318], resolved to consider the Faculty plan only when they had judged the merits of the various candidates[319]. There was very little time given for applications to be received, 3rd August being the closing date set by the Council. On the day that it had been decided to advertise the post, Richard Quain wrote to Sharpey[320], recommending that he come to London . . .

> **I am strongly of the opinion it would be to your advantage to come to town, <u>within a week or ten days</u> or a little more - <u>the sooner the better</u> . . . <u>do not omit testimonials, etc, if to be easily had</u> . . .**

Sharpey wrote his short letter of application on 29th July, 1836.

The Council met to consider the applications on 3rd August 1836 and on the following day a committee of the Senate was appointed[321] to report on the suitability of the candidates. Fourteen men applied, and of these, apart from the two internal candidates, Richard Quain and Robert Grant, nine were involved in teaching in the London schools. The Committee's report was very detailed and considered each candidate fully[322]. The criteria for selection were not set out, which was hardly surprising in view of the fact that the Council had not, at that stage, decided on the exact role of the occupant of the chair. From the report, though, it is possible to deduce that the committee were looking for experience in physiology; success in teaching, as shown by numbers attending classes and pass rates in examinations set by the licensing bodies; evidence of original work in papers and texts published; ability in languages; and teaching skills, several candidates having been observed in the lecture theatre.

Turner's opinion that an advertisement would attract a host of small men was shown to be accurate, and P B Lucas, from the recently opened Charing Cross School, and T J Pettigrew, a well known society surgeon who had done some lecturing at Charing Cross, were promptly dismissed as having too little experience. Dr King, who had reopened the Blenheim Street School and still promulgated the 'globule' theory, had his hopes dashed by Tyrrell's reference regarding his teaching abilities and his lack of judgment in submitting an application, while M W Hilles, it was felt, lacked reputation. Samuel Solly from St Thomas's was damned with faint praise, as being "a useful teacher", while Greville Jones did not even merit discussion.

The application of Herbert Mayo, from King's College, received a cautious response but the report gave a clear message . . .

> the committee acknowledges the great merit of Mr Mayo as an anatomist and physiologist . . . his appointment, as professor at King's College placed him in a situation which when that institution opened was one of great advantage; that nevertheless for some causes Mr Mayo has not been very successful as a lecturer and professor.[323]

It was Grainger and Sharpey who were the strongest contenders for the post. Grainger, however, offered to the committee no evidence of "possessing a sufficiently extensive knowledge of physiology", nor of having "studied those collateral sciences which are necessary to a physiologist". He was finally damned by his Birmingham accent - "The Committee are informed by Dr Davis, on his personal knowledge, that Mr Grainger's intonation in lecturing is, in his opinion, peculiarly unpleasant."[324]

William Sharpey, on the other hand, received a glowing report. His anatomical and physiological skills were highlighted . . .

> it appears that Dr Sharpey has made Anatomy his peculiar study, and possesses an extensive, very accurate, and minute knowledge of all its branches. To Physiology also, he has paid special attention; and although less his professional subject as a lecturer than Anatomy, it appears to be his favourite pursuit.

His publications were applauded, Bostock having been asked for his opinion on Sharpey's article on 'Cilia' in Todd's *Cyclopædia*. Sharpey's knowledge of the "literature of his science and profession, not only in his own language but in French and German" was recorded as an important attribute. The report advised that the testimonials in recommendation of Sharpey were very strong, and . . .

> the point on which they all dwell is the singular accuracy and minuteness and soundness of his very extensive knowledge . . . his method of communicating his knowledge both in speaking and in writing is described as plain but peculiarly clear[325].

Clearly the committee had no difficulty with a Scots accent! Reports of his punctuality and his obliging disposition, together with his being straightforward, gentlemanly and honourable, generally respected and loved, crowned this eulogy, leaving absolutely no doubt that the committee felt that in Sharpey they had found their man. Poor Grainger, regarded by many as no less honourable or respected, did not stand a chance.

Sharpey's testimonials, all from colleagues at the University of Edinburgh, which were read to the Council, had been submitted by Sharpey himself, and these, copied in his own hand, are still to be found in the collection of the Wellcome Institute.[326] They included the testimony of John Thomson, Professor of General Pathology; James Syme, Professor of Clinical Surgery; David Craigie, author and also by then Editor of *The Edinburgh Medical and Surgical Journal;* Robert Christison, Professor of Medical Jurisprudence; and William P Alison, Professor of the Institutes of Medicine. All these men had first hand knowledge of Sharpey's work and all spoke highly of his attributes. In open testimonials they were hardly likely to have done otherwise; Sharpey must, though, have had every confidence in his supporters, who had provided references at very short notice. The committee had observed that one of the most interesting testimonials was from Dr Hodgskin [sic], who was his fellow student in Paris. It had been thought that no copy of this testimonial had survived[327], but a thorough search of Hodgkin's correspondence has revealed his own copy in his letter book for that year. It was addressed to Dr A T Thomson [Anthony Todd Thomson, Dean, Professor of Materia Medica and Therapeutics at University College] and said that he, Hodgkin, had been informed that Sharpey was one of those to whom the Council were looking to succeed to the post of Professor of Anatomy. It is clear from the letter that Sharpey did not solicit the recommendation, which recounted their work together in Paris, and Sharpey's subsequent experience both abroad and in Britain. Hodgkin concluded that "were I to give way to petty jealousy, I might regret the accession of so much strength to your anatomical school, but I feel that I may desire the prosperity of the London University with undiminished allegiance to Guy's."[328]

Of the two internal candidates, Grant, who had applied for the post of Professor of physiology, was not considered. Richard Quain's application posed the committee a problem, not simply because he was one of their number, but particularly in light of the Senate's recommendations and the

Council's subsequent action. They concluded, however, that in soundness and extent of anatomical knowledge, in knowledge of the literature of his subject, and in general professional attainments, they considered none of the candidates but Dr Sharpey to be his equal, and Dr Sharpey not to be his superior. Dr Sharpey was considered, though, to be a great gain to the university, and in order not to lose the services of Quain, they recommended that Quain should be given the title Professor of Anatomy, placing him on a footing of equality with the new Professor of Anatomy and Physiology[329]. There was a clear assumption that Sharpey would be appointed!

There was a group of Professors, which included Henry Warburton [1784- 1858], who were not members of the Senate committee appointed to consider the applications, who lobbied, to no avail, for the appointment of Grainger. On 11th August, however, Quain's candidature having been withdrawn, and the Council resolved to appoint Sharpey to the chair, two of Grainger's supporters in the Senate voting against his appointment.[330] Sharpey was informed that the appointment would be subject to the modifications in contemplation for a new arrangement of the duties and emoluments of the chair of anatomy. This had distinct overtones of the earlier appointments to chairs in the College, but Sharpey was not put off, and two days later was introduced to his colleagues and took his seat on the Senate.[331]

Quain was not designated Professor of Anatomy until three months later. His role in Sharpey's appointment is enigmatic. Had the plan proposed by the Senate been agreed prior to the scrutiny of the applications, his post would have been secure. Taylor[332] has pointed out that it was not until after Council's decision to proceed in this way, that Quain made a formal application. Quain seemed not to have considered that, by promoting Sharpey, he could be undermining his own position. The letter to Quain informing him of his new designation, in November 1836, by which time Quain was Dean of the Medical Faculty, asked him . . . "to impart this information to Dr Sharpey."[333] Even though this was a request to Quain as Dean, it seems that the Council had learned little about man-management from their earlier experiences.

The Lancet[334] reported the various stages of the appointment. It accused the professors of intrigue and inappropriateness of selection, and denounced the system whereby the medical faculty had been allowed to exercise some control over the outcome. The report in this journal was far less circumspect in its comments on the various candidates than that prepared by the Senate. Mayo, it was presumed, had, as his chief claim to the consideration of the Council, his failure at King's[335]. Richard Quain, it was considered, would do well as the head of the department of Anatomy. This appraisal was accompanied by the view of *The Lancet*'s editor on the "nonsense and quackery in the new *divisions* of the science of Anatomy . . . we might as well have professors of 'fibrous anatomy', or 'cellular anatomy', or of 'reticulated anatomy' . . ." he maintained that anatomy was but one subject[336]. The reason for this view was not simply to promote the teaching of anatomy as one discipline, with Quain as its professor, but also to promote the re-establishment of the post of Professor of Physiology, and to secure the services of Robert Grant in that position. When Sharpey was appointed, *The Lancet* complained that he had "not the felicity of being known out of Edinburgh"[337]. He was described as "The Unknown Man from the North", and those responsible for his appointment accused of hypocrisy, treachery, envy and fraud. The profession and the students had, it said, been betrayed. *The Lancet* clearly had an informer on the Council as its discussions, and the details of the voting, were accurately reported in the press, which, nevertheless, agreed to give Sharpey "a perfectly fair trial".[338]

Some of the more objective comments in the medical press could be thought not unreasonable, particularly those comparing Sharpey with Grainger. Grainger had published his useful text[339], which was condemned in the committee's report[340] as being merely a compilation, and judged, on the basis that it had not been reprinted, as not bearing "a high character". Sharpey had prepared no text, and his publications were limited to his theses, a few papers, and his contribution to Todd's *Cyclopaedia*. Grainger's pupil numbers were acknowledged to be good, but they were then used to show that they indicated that Grainger, as an anatomy teacher, was "below the standard that the University of London has a right to look." Sharpey had undoubtedly been asked to enlighten the committee on the matter of pupil numbers, since he prepared a detailed explanatory statement[341], and the committee report recorded that Sharpey had pointed out that some students had neglected to register their tickets with the College of Surgeons, thus causing a discrepancy between his own records and those of the College. There is strong evidence to show that there was as much effort put into denigrating Grainger as into promoting Sharpey.

William Sharpey's early life, and his medical training in Scotland and in Europe has been described by Taylor.[342] His experiences were an excellent preparation for his new post at University College. He had entered the University of Edinburgh in 1817, where he studied Greek and natural philosophy before transferring to medicine. In 1821 he had gained the Diploma of The Royal College of Surgeons of Edinburgh, and, in the spring of that year had gone to London to spend three months studying anatomy at Joshua Brookes's school in Blenheim Street[343]. In the following autumn he had moved to Paris, where he studied surgery under Dupuytren at the Hôtel Dieu. It was in Paris that he first met James Syme [1799 - 1870], one of his referees for the post at University College, and with whom he remained friends for the rest of his life. On his return to Edinburgh, in 1823, he graduated MD, dedicating his thesis jointly to his father and to Robert Knox. Godlee has suggested that Sharpey and Knox were intimate friends and had thought to form a partnership, but for Knox's involvement in the Burke and Hare scandal in 1828[344].

Jacyna's analysis of the correspondence of Sharpey and Allen Thomson[345], indicates that Sharpey had been reluctant to engage in general practice, preferring to devote himself to anatomical and physiological pursuits, and had, accordingly, travelled to the Continent in 1827, going first to Pavia and then to Berlin. Sharpey's obiturist[346] recounted that . . .

> at Pavia under Panizza, and more especially at Berlin under Rudolphi, he dissected

> with great diligence, and made himself master of topographical anatomy. The writer has often heard him speak of his time at Berlin as one of sustained and severe labour. It was undoubtedly there that he especially trained himself for his future career."

In addition, his familiarity with the French and German literature and the contacts he made during his European travels . . . "were acknowledged by his contemporaries to have been amongst his greatest assets"[347]. His early contacts were, indeed, to feature amongst his colleagues and friends well into his old age. In his letter of application to University College[348] Sharpey described his work in Europe as being "in pursuit of Anatomical and Physiological knowledge", although in his rough draft[349] upon which he had obviously worked to achieve just the correct turn of phrase, he had first expressed this as "anatomy and physiology" which he had then altered to "anatomical and physiological anatomy".

Sharpey's teaching had begun on his return to Edinburgh in 1830, having been admitted as a Fellow of the College of Surgeons there. His partner was John Thomson's son, Allen Thomson [1809-1884], with whom he had spent time in Paris. In the Edinburgh extra-mural school, Allen Thomson taught physiology and Sharpey anatomy. It was the success of this school, particularly in terms of the number of students in the classes, that Sharpey emphasised in his application, and which was taken as a mark of his success as a teacher.

That Sharpey was an early user of the microscope is in no doubt, his work beginning before the advent of the achromatic compound microscope. In his address to the annual meeting of the British Medical Association in 1862, Sharpey recounted that . . .

> twenty five years ago I was amongst the very few medical teachers in this country who exhibited objects to students with the microscope . . . I remember, too, the time when we had to work laboriously with small lenses, by reason of the defects of the compound microscope . . .[350]

Jacyna has interpreted "the great advantage as a teacher in having studied the methods of instruction in the best continental schools", which the committee accorded Sharpey on his application to University College, as including his use of the microscope as a teaching tool, a method that both Sharpey and

Thomson, he said, would have learned during their visits to German medical schools[351]. None of Sharpey's referees however, nor yet he himself, draw attention to such a fact, and it is not clear exactly where he gained this important skill. His own statement to the BMA indicates that it was only after he took up his post at University College that he began to use the microscope as a regular adjunct to his anatomy teaching.

Sharpey's paper on cilia[352] indicates quite clearly, though, his use of a microscope in his private research. In this paper he reviewed the work of many microscopists, from Leeuwenhoek right up to the time of his writing, in 1835. He included the description of a zoophyte, by J J Lister, which had been published in *Philosophical Transactions*[353] of the Royal Society in 1834, and a very recent paper by Purkinje and Valentin which had appeared in Müller's *Archive*[354] in 1835. It has been shown above that the superior achromatic compound microscope, produced following Lister's work, was by no means commonplace in the early 1830s in Britain. Coleman[355] has recounted that Purkinje began his microscopical researches in the 1820s with a simple lens, but it was not until 1832 that he received a Plössl microscope in Breslau, which, despite its optical limitations, would have enabled him to have pursued his enquiries with confidence. In Berlin, Henle began offering courses on general anatomy, in which he brought the microscope into the classroom, only in 1837. Tuchmann[356] has described how, as late as 1834, the University of Berlin had only one microscope, and that Müller's students had to be content with theoretical explanations. It seems unlikely, therefore, that any other than a simple microscope, as a regular teaching tool, was in use by Sharpey in Edinburgh.

On his appointment, Sharpey took up his post immediately, and the prospectus for the Medical Faculty, for the winter term of 1836, announced that his lectures would include: an introductory view of the structure and functions of the human body; the general anatomy of the tissues of which the several organs of the body are composed; the anatomy of the nervous system, of the viscera, and organs of the senses, with a connected and comprehensive view of their functions, embracing the established facts and leading doctrines of physiology. The attention of the student, would, it said, be directed throughout to the intimate structure of organs and the history of their development. This course, with the exception of the work on physiology, closely parallels that offered by Bennett, when the original anatomy course was divided between him and Pattison.

The Repercussions at King's College.

The events at University College had repercussions at King's College, a mile away in the Strand. Mayo had applied for the post at University College on 1st August, 1836. His letter of application[357] indicates that he was familiar with the medical faculty plan to create two professors of anatomy. He therefore supported Richard Quain for the post of Professor of Descriptive Anatomy and proposed himself for that of General Anatomy and Physiology. This, he understood to mean, included the responsibility for the course of instruction . . "in which the elementary textures of the frame and their properties are examined . . ." A version of Mayo's letter of application, together with what purported to be a covering letter to a confidant, was published in *The Lancet* under the heading of 'Intercepted letters', a regular, mischievous column, said to be contributed by James Wardrop, using information received from Sir Benjamin Brodie and Sir Henry Halford.[358]

It is not clear why Mayo applied for the post, although it was more likely to have been his wish to leave King's, than his confidence in gaining the position at University College. In June responsibilities at King's had been reordered, so that Mayo had become Professor of Physiology and Surgery, while Partridge was created Professor of Anatomy, with the fees for the classes being divided equally between the two.[359] It is obvious from correspondence, now lodged in the archives at the College, that Mayo had become a figure of ridicule. Professor Daniell, in a note to Partridge, following a request for a reference from University College, refers to Mayo as 'Murphy's potatoes' and asks for Partridge's view on his, Daniell's, 'specimens of Jesuitism', namely letters to both Turner at University College, and to Mayo. To Turner he wrote . . .

I have no hesitation in saying that his powers of communication orally are very great, that the roughest notes are sufficient to guide him in his discourse and that his general acquirements enable him to enliven his subject with the happiest illustrations, . . .no one knows better that[sic] Mr Mayo how to render himself a favourite with the pupils."[360]

This letter was copied to Mayo, with Daniell's comment that both his compliance or refusal to supply a reference could be open to misinterpretation. The content of the reference, however, could have left no doubt in Mayo's mind of the true state of affairs.

Mayo's colleagues called on him to resign[361] and, as Professor Green wrote to his colleague, Partridge[362] . . .

I really do not see how the professors could have acted otherwise, as it is quite clear that all confidence in Mayo must be gone, with the thorough conviction that he will be at all times ready to sacrifice the welfare of the school of King's College to his own, at any rate fancied, interest."

Mayo felt obliged to resign when he received the note from his colleagues and did so formally on 5th August.[363] On the 11th, however, having been unsuccessful at University College, he wrote to Watson, saying that, as there had been no meeting of the Council, his resignation could not have been officially received, and . . ."I distinctly withdraw my resignation."[364] His colleagues were equally determined and requested "by unanimous desire" that the Council, in the interests of the College, receive Mayo's original resignation[365]. This the Council did, on the recommendation of the Education Committee. In the same recommendation the committee proposed that Professor Partridge be appointed Professor of Descriptive and Surgical Anatomy and that Professor R B Todd be appointed Professor of Physiology, and of General and Morbid Anatomy.[366]

The University of London.

Relationships between University College and King's College were not necessarily uncordial, nor were they unacquainted with each other's activities. There were links between the two at a number of levels. Lord Brougham, the chairman of the Council at University College was, as Lord Chancellor, an ex-officio governor at King's. At a more domestic level, but probably one at which news travelled best, Lyell, from King's, was engaged to the daughter of Leonard Horner, the Warden at University College.[367] Several professors at the two institutions, particularly in the medical faculties, were known to be on good terms and Hearnshaw[368] records that they met to discuss the possibility of some sort of joint action to improve the system of medical education in London, by establishing a degree course. They had felt that it was improbable that any government would establish two degree-conferring institutions simultaneously and that some form of joint scheme would be desirable. The medical professors at King's submitted a plan[369] to their Council, advocating a three year course, which accommodated all the requirements of the Society of Apothecaries, The Royal College of Surgeons and The Royal College of Physicians, leading to the award of Bachelor of Medicine and of Surgery. This plan would have involved the two institutions becoming federated for examining and degree conferring purposes. Not surprisingly the Council told them to mind their own business[370]. On the issue of obtaining a Charter, and hence the right to grant degrees, each Council wished to have priority.

As early as 1828, *The London Medical Gazette*[371], had taken University College to task for calling itself a 'University', which, it said, implied a Royal Charter, and the power of granting degrees; it would have been better, it went on, had it been called the London College and at some future period His Majesty might confer one charter on both it and King's College, combining the two into 'London University'. University College, however, in 1834, petitioned for a Charter of Incorporation, empowering them to confer degrees. This was strongly opposed, not only by the universities of Oxford and Cambridge and by the chartered corporations, but also by the medical lecturers in London, who saw such a development as creating a new and unjust monopoly in medical teaching. A petition of opposition by the medical teachers, with ninety eight names appended, was drawn up.[372] Teachers of anatomy were prominent amongst them, including those from all the hospital schools and many private medical schools. The petition was turned down.

When, in 1834, the House of Lords had rejected a Bill passed by the Commons, which would have enabled dissenters to be admitted to Oxford and Cambridge, those wishing to promote the establishment of a degree awarding University in London, had additional reason for urging their claim. In 1835 an Address was presented to the Crown, praying that a Charter might be granted to the institution then known as the London University. This petition was referred to the Privy Council, and as a result a scheme was proposed by Lord Melbourne's Government. This scheme was to provide a mode of granting Academical Degrees in London to persons of all religious persuasions, without distinction and without the imposition of any test or disqualification. The essence of the proposal was the granting of Charters, Incorporating University [henceforth to be known as London University College] and other Colleges, but also the granting of a Charter

> to persons eminent in literature and science, to act as a Board of Examiners, and to perform all the functions of the Examiners in the Senate House of Cambridge; this body to be termed the 'University of London'.[373]

The Charters were granted on 28th November 1836. The proposals amounted to a declaration that the business of teaching should be confided to the Colleges; but that the duty of examining, of awarding prizes, and of conferring degrees should be entrusted to an entirely separate and independent body to be called the University of London.

Thomas Hodgkin, a dissenter, was actively involved in the affairs of the new university. He wrote an outline plan[374] for its future constitution and in 1837 he was invited to serve as a member of its governing body, the Senate, which he did until his death. Another well known anatomist who was active in the formation of the university was Francis Kiernan. He, too, was a member of the Senate from the first, and, with Sharpey, was early elected an Examiner in Anatomy and Physiology.[375]

Francis Kiernan's name had been linked with that of J R Bennett, in Armstrong's paper which denounced their treatment by the Royal College of Surgeons. Kiernan had been a very successful student at St Bartholomew's Hospital; so successful that he had established a private anatomy class in his rooms in Charterhouse Square. Despite the support of the surgeons at the hospital, Vincent, Lawrence and Lloyd, who cited his anatomical and surgical experience in France and Italy as having qualified him admirably for the role of teacher, The Royal College of Surgeons refused to receive his certificates. Kiernan, thus deprived of his occupation as a teacher, turned to minute anatomical investigations, and began his work on the anatomy and physiology of the Liver. [See pp. 122-123 below]. The result of his investigations was published, in 1833, in the *Philosophical Transactions*[376] of The Royal Society, to whose Fellowship he was at once elected, and by whom its Copley Medal was awarded. Kiernan's concern for religious tolerance in medical education would have been enhanced when early appointments were being discussed at King's College. His obiturist in *The Lancet* records that when King's College was founded, negotiations had led to Mr Kiernan's presenting to the then embryo museum at King's, a number of his valuable injections of liver, but that this did not lead to his receiving an appointment.

> Religious scruples, curiously enough, came in the way of the King's College authorities, when the question of appointment was mooted, and, as Mr Kiernan declined to change over from the Romish to the English Church in order to secure the chair, he was left out in the cold, but the preparations are still at King's College![377]

The Lancet[378] was quick to observe, that the proposal to establish a new university in London, did not affect, even remotely, the cause of medical reform, as it was not in the power of the Crown to abrogate the rights of the medical corporations. While this observation was technically correct, it did not give credit to the Government, or, at least, to the promoters of reform within it, for the setting up of a Select Committee to enquire into the state of the medical profession, and within it, of medical education. Thomas Wakley, the editor of *The Lancet*, did not become a Member of Parliament until 1835, but he worked to seek legislative means of reform with Henry Warburton FRS, MP for Bridport, who was also a member of the Council at University College. Warburton, "a man of sound sense and judgement, and of high personal integrity"[379], had the confidence of the House of Commons, and was appointed Chairman of the all-party Committee. Newman[380] has summarised the outcome of the work of the committee, which printed the extensive evidence brought before it in full[381]. He suggested that letting those in power in the medical world convict themselves on their own evidence was an effective means of bringing home the fact that changes in practice were needed. Holloway has pointed out that a significant fact to emerge was that there was general agreement among the London hospital surgeons that the ancient boundaries of practice had broken down[382]. Loudon, too, has made an excellent analysis of the differentiation between medical practitioners, emphasising the status of the general practitioner[383].

Changes in the Curriculum.

The Society of Apothecaries had, meanwhile, set out new regulations[384]. For candidates beginning their studies in October 1835, these altered the length of courses, the order in which they were to be studied, the season in which they were to be delivered, the extent of hospital attendance, and changed the entire period to be spent in professional study. In anatomy and physiology, attendance had, prior to this, been required at one hundred and forty lectures, occupying no less than one hour each, and one hundred demonstrations. It had been recommended that students avail themselves of instruction in morbid anatomy, and to attend clinical instruction. The new arrangements required, amongst other details, that anatomy and physiology and anatomical demonstrations should be delivered in two courses, in the first and second winter sessions respectively, and that dissections take place in the second and third winter sessions, together with principles and practice of medicine. Medical practice in a hospital was not to begin until the second year. Looked at objectively, this would appear to present a logical arrangement for teaching, enabling the student to obtain a grounding in theory, before beginning practice.

The response was, as may have been expected, immediate. *The London Medical Gazette*, which had in 1832[385] applauded the Society of Apothecaries for including such a variety of disciplines in a two year course, said in its editorial . . ."verily the Worshipful Society have gone somewhat beyond the mark."[386]

The journal felt the new curriculum ill-timed and regretted that such a moment [when the Select Committee had been established] should have been selected for proposing measures, which would, it judged, produce a complete change in the whole system of medical education. Oddly enough, it felt that the most palpably objectionable part of the new regulations was the . . ."gratuitous and absurd announcement that there is to be a recess of fourteen days at Christmas, and one of like duration in April."! The editorial went on to point out how harassing and perplexing it would be for the student to have two entirely distinct, and in some degree rival bodies, claiming their allegiance - the Society of Apothecaries possessing a legal authority and the College of Surgeons a conventional sway, and concluded by advocating a common route for all medical studies.

This appeal for a common route echoed that made by Lawrence, Wakley and other reformers ten years previously, but another half century would elapse before that particular dream was to come true. Many changes, though, had taken place over the decade, inextricably interlinked, but each, in its own way contributing to the gradual progress in medical education and to the teaching of general anatomy in particular. The new concepts and skills brought from the Continent had become established in the lecture courses, offered not only in the hospital medical schools but in the smaller private anatomy schools as well. The establishment of University College and of King's College provided medical students, for the first time, with a planned and integrated course which covered the whole of the medical and surgical curriculum. As their reputations grew, able teachers were attracted to their lecture theatres and dissecting rooms, so that by 1836, with Sharpey and Todd in their key posts the scene was set for skilled teaching in general anatomy. The establishment of medical faculties, and the firmer links between hospital practice and more theoretical teaching, both in the colleges and the hospital medical schools, meant that teachers could work together to their mutual advantage, not only in practical terms but also in the propagation of the newer medical concepts. In this way, the development of clinical medicine, the art of diagnosis, the study of morbid anatomy, the classification of disease, and, in consequence, the increased understanding of appropriate therapeutic action was being fostered.

The understanding of the structure of the tissues progressed over the decade, not only as a result of the work of Bichat and his followers, but also because of the improvement of the optics of the microscope, which enabled men to see more clearly their true nature; not that, at this stage, this nature was clearly defined. The publication of texts and journals, the easier dissemination of information, and the increasing ease of travel, meant that men could discuss theories and collaborate with colleagues, both in Britain and abroad, and that students could gain better access to new work.

The monopoly in training was still vested in the great medical corporations, but the efforts of the reformers had brought about many changes, not least the establishment of University College, with its "new men". The newly chartered University of London promised to open up a new chapter in medical education, and certainly, by admitting key people, such as Hodgkin, Sharpey and Kiernan to examining board and governing body, ensured that general anatomy would remain an important part of the curriculum

It was *The London Medical Gazette* which had, in 1828, predicted that, with the establishment of University College and King's College, most of the small medical schools, and all of the small fry of private teachers, would be crushed and swallowed up by the two great schools, and that the only students found frequenting the large hospitals would be an elder class, whose education was almost finished, who were past lectures, and who wished only to observe disease on a large scale before embarking on the practice of their profession[387]. It was to be proved wrong, however, admitting seven years later[388] that . . . "we never recollect having seen the announcements of the different schools more attractive as well as numerous, nor the promise of their performances more likely to be satisfactorily fulfilled." It is this fulfilment, in the form of the new generation of great teachers in the schools, that is the subject of the next chapter.

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CHAPTER TWO.
MICROSTRUCTURE COMMUNICATED: 1836-1854.

This chapter examines the influence of new theories and changing attitudes on the approach to the teaching of general anatomy, increasingly referred to as histology, in the London schools between 1836 and 1854. It traces the incorporation of developments in the study of histology into the teaching programme, using the understanding of the structure of the liver as a case study, and reviews the position and the importance of the emerging discipline in the medical curriculum.

The Cell theory in relation to histology.

The history of the cell theory has already been thoroughly explored. Hughes[1] placed the recognition of the cell in the context of the development of microscopical observation, while Hall[2] appraised the work of Schwann in the continuum of the research and discovery of the nineteenth century. The series of papers by Baker[3] offers an excellent, detailed "Restatement, History and Critique" of the theory. It is necessary here only to discuss the effect of the cell theory on the development of the study of histology and upon the subsequent teaching of the subject in the medical schools.

Baker has suggested that Schwann's definition of the cell theory was best expressed in his contribution to the work of another author . . . "A common principle of development is the basis of all organic tissues, however diverse they may be, namely, cell-formation; . . ."[4]. Schwann clearly saw the impact his work would have on the classification of tissues. In his *Microscopical Researches* he stated that . . .

> since all organic structure is primarily formed of cells, the most scientific classification of general anatomy would manifestly be one founded upon the more or less high degree of development at which the cells must arrive in order to form a tissue."[5]

That the cell theory had important effects on the study of histology and on embryology is clear. Virchow, who went on to refine the cell theory of Schwann, wrote . . .

> The eternal merit of Schwann does not lie in his cell theory . . .but in his description of the development of the various tissues and in his demonstration that this development (hence all physiological activity) is in the end traceable back to the cell"[6].

Common both to the view of Schwann and of Virchow was the fact that the process of cell production was a critical point from which further investigations in the microstructure of the tissues and of the organism could be developed.[7]

It is remarkable that Schwann's *Microscopical Researches* was not translated into English until 1847, by which time it had earned him the Copley Medal of The Royal Society of London. The translator, Henry Spencer Smith [1812-1901], apologised for the delay, blaming unforseen professional and domestic problems. Smith had been apprenticed to Skey at St Bartholomew's, and had spent six months in Paris in 1837 studying medicine. He then studied science in Berlin from 1839 to 1841. On his return to England he became surgeon to the Royal General Dispensary in Aldersgate Street[8]. When the volume finally appeared it had been revised by Schwann and was bound together with a translation of Schleiden's monograph to which Schwann had made reference.[9] Smith's biographer records that both translations gave an impetus in this country to the microscopic study of the tissues.[10]

Jacyna[11] considered that the reception of Schwann's hypothesis in Britain prompted the pursuit of existing microscopical enquiries, rather than initiating novel lines of investigation. He pointed out that it has been sometimes assumed that the technical advances made in the construction of the optics of the microscope in themselves made possible the development of cell theory, and that the differences between what Bichat and Schwann said about animal tissues was a technological one. Jacyna considered, too, the fundamental differences in outlook between the two, which could not be accounted for merely by saying that one pursued histology at the macroscopic and the other at the microscopic level. He placed the work of the two investigators in the context of the theoretical structures with which they worked, and in the wider cultural milieu.[12] He quoted Churchill[13] as having written that, far from resolving uncertainties about the minute structure of tissues, "the new microscopes of the 1830s brought chaos into anatomical and pathological studies."

It was no coincidence that the cell theory was formulated by German workers. The work of Schleiden and Schwann was based on the use of the achromatic microscope, Schwann having been a pupil of Johannes Müller [1801-1858], whom Garrison described as the founder of scientific medicine in Germany[14]. Müller had been one of the first to use the achromatic microscope, giving an impetus to histological studies which were to prove a distinguishing feature of German medicine[15]. Müller investigated the minute structure of glandular and cartilaginous tissue and published numerous papers, and was the teacher and mentor of not only Schwann, but, amongst others, Henle, Kölliker and Virchow. Both Henle and Kölliker wrote influential textbooks which incorporated the new cell theory of Schwann, and so it became adopted by teachers of microscopic anatomy.

In his researches of 1836-7[16] Henle had laid the foundations for the modern understanding of epithelial tissues, viewing the tissue cells in their functional and developmental, as well as their structural relationships. His *Allgemeine Anatomie*[17], was published in 1841, when he was Professor of Anatomy in Zurich. It was the first text on microscopic histology. Garrison[18] described his classification of tissues in the work as the simplest and best ever made. Robinson also quoted the cytologist Walther Flemming [1843-1915], in saying of Henle . . .

> two years after the publication of Schwann's book, he published his General Anatomy; and one may say that this contained the first real, rational tissue theory of the animal body, so comprehensive and many sided, that it earned the admiration of the entire biological world.[19]

Henle's text was not however translated from the German.

Rudolf Albert von Kölliker [1817-1896] was Henle's prosector and was, according to Robinson, one of the greatest histologists of all time . . . "with the microscope he brought to the archaic town [Würzburg], Kölliker built temples of science where succeeding generations shall dwell"[20]. His *Handbuch der Gewebelehre des Menchen*[21] was published in 1852, and translated into English in the following year. [see page 196 below]

An early commentator on the cell theory and microscopical researches in Britain was R D Grainger. The *London Medical Gazette* published, in November 1842, his paper *Microscopic Researches in Anatomy*[22]. By this time Grainger had been appointed lecturer in anatomy and physiology at St Thomas's Hospital Medical School, but it is not clear to whom the paper was addressed. The editor of the *Gazette* stated, however that the meeting included a considerable number of non-professional men, and hence the paper was necessarily restricted to general allusions, minute details appearing to Mr Grainger unfitted for a mixed audience. Grainger began by exhorting his listeners to make better use the microscope . . .

> if it be admitted that the aim of the anatomist is to discover the true structure of the human body, he must either avail himself of the use of the instrument, which affords the only means of rendering the internal composition of the several organs apparent to the senses, or rest satisfied to abandon, as beyond his power of demonstration, those very parts of his animal frame which are of the deepest interest to the physiologist and practitioner of medicine.[23]

He then referred to "a series of investigations which have thrown a new and unexpected light on some of the most important laws which regulate the growth and formation of organised structures" and gave a brief account of the work of Schleiden and Schwann, describing it as "one of the most brilliant discoveries, which perhaps, has ever been made in connection with the science of organisation". He mentioned the names of those currently working in the field of tissue and cell structure, including those of Henle, Sharpey, Purkinje and of Bowman, whose paper on muscle was one of those which "commands the attention of microscopic observers." It was through the kindness of Bowman, Dalrymple and Quekett, of the College of Surgeons, said Grainger, that he had had the opportunity of inspecting the various organs prepared by minute injection. The combined use, he said, of the microscope and minute injection was evidently introducing a new era into the history of anatomical preparations.[24]

Some years later, in 1848, Grainger delivered the Hunterian Oration at the Royal College of Surgeons, entitled *Observations in the cultivation of organic science*. In this he stated that . .

> it may be unhesitatingly affirmed that of all the means yet devised for demonstrating the structure of the human body, none are comparable, as to exquisite clearness and distinctness, with those afforded by well prepared microscopic specimens. No dissection, however minute, no preparation which is the mere production of a scalpel, can approach in delicacy, definition, or beauty, to the results of minute injection or successful sections.[25]

The state of the art of microtechnique at that time had been set out by R B Todd in his Gulstonian lectures for 1839, delivered at the Royal College of Physicians, and reported in the *Gazette*[26]. In the third of these "On the structure of the mucous membrane", he emphasised the need for an accurate knowledge of minute structure, if correct deductions were to be made from a physiological point of view, and added that it could scarcely be expected that any degree of success could attend researches into the morbid changes of any structure, if the observer was ignorant of its anatomical characters in health. Notwithstanding, he said, the attention which had been given to the investigation of the anatomy of the tissues, in France and Germany especially, and in a less degree in this country, little advance had been made, although recent microscopical investigations had completely revealed the minute anatomy of the mucous membrane. Todd went on to outline the various modes of examination of tissues which he used in his own investigations. These included injection, stretching a portion on a plane surface under water; cutting thin sections vertically and horizontally, for examination either as transparent objects if cut thinly enough, or examined on a background as opaque objects. Todd's paper thus gave a contemporary summary of the common techniques used in the microscopical investigation of tissues in the late 1830s and the 1840s. It is important to recall though, that until that period, most work with tissues under the microscope was done with fresh material, dissected and/or compressed until thin enough to see through.[27] Bracegirdle has already given an illustrated and fully documented history of microtechnique[28]; it will be necessary here to give detail only as it affects the progress of teaching histology in medical schools.

Grainger contributed four essays to the "Anatomy, General or Physiological" section of Todd's *Cyclopaedia of Anatomy and Physiology*, the first two volumes of which were published, in parts, between 1836 and 1839.[29] His papers included those on Cellular tissue, Fibrous tissue and Gland. That on cellular tissue, which predated the work of Schwann, was concerned with what is now described as connective tissue, rather than with the cell as the structural basis of all tissues.

British and Foreign Textbooks.

A survey of textbooks of the period has revealed not only what was available to teachers and students, but also how the results of original investigations were incorporated into texts. Chen and Chen[30] have already traced the history of the understanding of the structure and function of the liver, but in this present thesis the development of that understanding through its communication by papers and texts will be used as a focus in the various editions and translations.

The January 1838 issue of *The British and Foreign Medico-Chirurgical Review*[31] included comment on the texts of Quain, Mayo and Müller, while previous issues[32] had commented on Meckel's work and that of Bostock and of Hodgkin. The review of the first volume of Hodgkin's *Lectures on the Morbid Anatomy of the Serous and Mucous Membranes*[33] was highly complimentary . .

> It is scarcely doing justice to our judgement to say that the work is simply good; it is in every respect an excellent production; calculated to advance the progress of pathological science, and destined to take a permanent place among the higher order of the medical classics of this and other countries.[34]

Bostock's third edition of *An Elementary System of Physiology*[35], "revised and corrected throughout" was criticised only in that instead of interweaving the new material into the text, Bostock had appended it in note form, so that . . .

> the consequence of the plan adopted by the author is, that in some cases the notes are almost unconnected with, if not actually opposed to, the matter in the body of the work . . . an error may be thus propagated which might have been easily avoided by a little more trouble.[36]

Nevertheless the review concluded that "in point of extent and completeness, indeed, this work must take precedence of any other in our language."[37]

It was neither the extent nor the completeness that was criticised in the translation of Meckel's *Manual of General Anatomy*[38], but the translation . . .

> we have always objected to a work being translated through two languages . . . we find many inaccuracies in the text thus produced . . . the quality of information which has been accumulating through the last five or six years is much too valuable and too

> abundant to be overlooked in translation which professes to supply commentaries on the original.[39]

The review went on to advise Dr Doane, the translator, to study German before attempting to translate other German works. With carefully worded criticism the text was described as being

> useful to the English Student . . . its conciseness, and the great mass of interesting and important matter contained in it, cannot fail to render it a valuable acquisition to all who are ignorant of the language out of which it was translated.[40]

The review of Baly's translation of Müller's *Elements of Physiology*[41] was in a very different tone . . .

> after having compared a considerable portion of the translation with the original, we are bound to express our unqualified approbation to the manner in which Mr Baly has executed his task. The translation is not only faithful and accurate, but elegant, and reads throughout (with very few exceptions) like an original English work . . . we consider the English student, and indeed the whole profession, under great obligation to Mr Baly for the very important addition which he has made to the medical literature of this country; and we recommend his work, in the strongest terms, to all our readers who do not possess the original treatise.[42]

William Baly was a graduate of the University of Berlin, where Müller was Professor of Anatomy and Physiology. Müller's text had been published in 1835[43] and Baly had, while being careful to render a faithful version of the original, attempted to make his translation "fitted to the wants of the student" by adding newly discovered facts, omitting some parts which may have "formed a digression which tended to interfere with the student's reading" and "to facilitate the labours of the student, the paragraph where a new topic commences, has been headed with a short statement of this in italics"[44]. The volume had also been enhanced by steel plates and woodcuts, the same artist, Mr W Bagg, having also made the drawings for Quain's new edition. Baly acknowledged the assistance of Mr Quain, Dr Sharpey and Dr R Willis, whose advice, he said, had mainly guided him in the execution of his task.[45]

The very detailed and readable text, together with the translator's notes, gave a clear picture of the understanding of animal physiology at that time. They also gave an indication of the extent to which the German school was aware of progress in Britain. Each section, for example that on secretion, included a description of the minute structure of the tissues and organs concerned; the liver being grouped with the lachrymal, mammary, and salivary glands and the pancreas, under the translator's sub-heading "Compound glands formed of ramified cæcal canals"[46]. He acknowledged the work of Kiernan on the anatomy of the liver and also challenged his findings[47]. On the subject of blood, however, Müller seemed unaware of the British work, and Baly noted that . . ."Professor Müller is evidently not aware that the most important facts stated in the following description of the red blood particles of the blood were ascertained long ago in this country, although they have since been neglected."[48] Under the heading of "Secretory apparatus" Müller gave to what has previously been called "cellular tissue" the name "connective tissue". He did so, not in the light of the investigations of Schwann, who at the time of publication was simply assisting him, but

> in consequence of physiologists having begun to adopt the opinion of Bordeu, Wolff and Meckel who regarded it as a kind of mucus filling the interstices of the texture of organs, and supposed that its apparently membranous and cellular structure is produced by the action of air, by traction, or by the infiltration of fluid.[49]

Details of Schwann's five classes of tissues were given, together with drawings described as "after Schwann". Schwann's discoveries, Baly said, were to be ranked amongst the most important steps by which the science of physiology has ever been advanced.[50] Baly's translation went into a second, two volume edition, in 1840-1842, by which time he had become lecturer in forensic medicine at St. Bartholomew's Hospital.

The review of Baly's translation of Müller was in the same report as that of Mayo's fourth edition, which was described as being "planned and executed in a very different style, which we regard as peculiarly characteristic of the English School of Physiology".[51] This rather enigmatic comment suggests that the *Review* considered that in England, at that time, the texts that were being published were largely revised editions of earlier works and that little that was fresh and new had been produced. Mayo's *Outlines of Human Physiology* was regarded as an elementary treatise which was practically useful, but did not compare with Bostock's, if the student wished to receive a large increase in knowledge of the history and facts of his science. The review was very critical of the chapter on blood . . ."although much addition has recently been made to it, the author has neglected many observations of superior importance, which ought unquestionably to have been introduced . . .". However it was felt that . . .

> we cannot leave the subject of secretion . . without expressing our great satisfaction with the very clear and concise analysis which Mr Mayo has given of Mr Kiernan's discoveries in the anatomy of the liver.

In conclusion the review considered that . . . "it wants but to be continued with the same zeal and industry with which it was first compiled, to be rendered one of the best elementary works on Physiology, not only in our own but in any language."[52]

Quain's fourth edition had a much warmer reception . . ." of all the manuals of anatomy for the use of students that have yet to come before us, Dr Quain's is certainly the best; and the present edition, owing to the numerous and beautiful plates and woodcuts with which it is for the first time illustrated, is very superior to the preceding."[53] The *Human Physiology*[54] of John Elliotson, Quain's colleague at University College, however, was condemned as "unfit for the professional student".[55] Craigie's second edition[56], which appeared as late as 1848, fared little better! The review considered that *"not a single fact, or new idea"* had appeared in the whole volume. The author had, in his 'Advertisement' which prefixed the text, said

> by some it may be expected that this work should have been illustrated with delineations, more especially with reference to microscopic anatomy. These, however, would have added so much to the expence of the work, without otherwise increasing its value, that it was thought best for the present to dispense with their assistance.

The reviewers described this statement as "singular" and declared themselves to be amongst

> the contemptible 'some' who think that blood, osseous, and cartilaginous tissues, the membranes and glands . . . . . falling within the scope of general and pathological anatomy, cannot be properly explained without diagrams or plates, illustrating their minute structure and arrangement. If we are wrong in expressing of this opinion, we err with Müller, Henle, Valentin, Gluge, Vogel, Lebert, and all the best anatomists in Europe, to say nothing of our own countrymen, Todd and Bowman, Sharpey, Carpenter, Goodsir and Hughes Bennett[57].

The review considered that the histology of muscle, for example, as described by Todd and Bowman, by Sharpey and by Carpenter was perfectly intelligible; but "clear as their descriptions are, few (we doubt if any) readers would clearly understand their meaning, if it were not for numerous illustrations".[58] The author, it was felt, had left his observations in much the same state in which they existed in 1828, when the first edition appeared, but "as we are anxious to avoid any semblance of hypercriticism, we will merely remark that Dr Craigie is sadly behindhand".[59]

The *Review* had identified in this report the new work which had been produced by British authors in the late 1830s and the 1840s. Before the impact of both the foreign translations and the new British texts on the teaching in the medical schools is assessed it is necessary to discuss the paper by Kiernan to which most of the texts refer. Kiernan's paper, *The Anatomy and Physiology of the Liver*[60], was read to the Royal Society on June 20th, 1833. In it he referred briefly to the work on the structure of liver of Malpighi[61] and of Müller[62], before describing in detail his own investigations. These he dealt with in three sections: the arrangement of the lobules, and their connections with each other and with the vessels; the surfaces of the liver and the distribution of vessels; and the structure of the lobules. As Chen and Chen have pointed out, the lack of an achromatic microscope did not hinder Kiernan from his outstanding contributions to the understanding of the structure of liver.[63] Kiernan worked with a low power lens on both fresh and injected material, using a wide range of animals, but mostly pig, for his investigations. He gave very clear explanations for his method of injection, using red and blue size (gelatine solution), and the more difficult to use, but excellent in result, mercury, as injection fluids. . . "the veins and fissures cannot always be seen without the aid of a magnifying glass; slight pressure, however, by which the blood is propelled into them, will generally make them visible. They may be always seen after a few hours maceration in water, or they may be shown by mercurial or size injections."[64] Kiernan described the basic unit of the liver as lobules arranged around the hepatic veins[65]. His description of the structure of the individual lobules, which he recognised as the secreting portion of the

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Examined with the microscope, the injected interlobular ducts are seen dividing into branches, which, entering the lobules, divide and subdivide into minute ducts; these ducts anastomose with each other, forming a reticulated plexus. (Plate XXIII. fig. 3.)

Figure 2.
F Kiernan (1833) - The anatomy and physiology of the liver,
Phil.Trans.R.S.,1833, 711-770.
Plate XXIII.

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liver, required the use of a microscope . . .

> Examined with the microscope, a lobule is apparently composed of numerous minute bodies, of a yellowish colour (imparted to them by the bile they contain) and of various forms connected with each other by vessels. These minute bodies are the *acini* of Malpighi.[66]

He credited Müller with having thrown much light on the ultimate structure of glands . . . "the gland is a duct with blood-vessels ramifying on its parieties"[67]. Each lobule, he said,

> is composed of a plexus of biliary ducts, of a venous plexus formed by branches of the portal vein, and of minute arteries; nerves and absorbents, it is to be presumed, also enter into their formation, but cannot be traced into them . . . the form of the lobules bears no relation to the arrangement of the ducts, the form of each lobule being correspondent to the branches of the intralobular hepatic vein occupying the centre of the lobule[68].

Kiernan found the human liver hard to inject . . . "in consequence of its double venous circulation" . . . and was uncertain, having followed a variety of injection techniques, how the lobular arteries and veins terminated . .

> it is probable that the lobular arteries terminate in the lobular venous plexuses formed by that vein, and not in the intralobular branches of the hepatic veins, which cannot be injected from the artery, the blood of these arteries, after having nourished the lobules, becomes venous, and thus contributing to the secretion of the bile.[69]

Kiernan explained how he had investigated the structure of the lobules and satisfied himself . . "by repeated injections, by examination with the microscope, and by experiments on living animals, that the lobules are the same structure throughout."[70] Chen and Chen, in their history of the understanding of the liver, have shown that Kiernan's concept of lobular organisation of liver became the accepted model of hepatic microstructure, and that this lasted for more than a century.[71] Kiernan's paper was illustrated with his own clear drawings, which became the main source of diagrams to accompany descriptions of the structure of liver in the leading general texts of the period. [See figure 2].

Quain's third edition of *The Elements of Anatomy*, published in 1834[72], was the first of the British general texts to refer to Kiernan's work. Quain first described the gross anatomy of the liver, as in previous editions, and then added "The recent researches of Mr Kiernan give a very clear view of several

Figure 3.
Jones Quain - *Elements of anatomy.*
London: Taylor and Walton, 1837.
Plate II.

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points connected with the distribution of vessels in the liver, and particularly of the structure of the lobuli"[73]. He went on to describe some aspects of Kiernan's injection techniques and then simply referred his readers to the original paper.[74] Quain's fourth edition of 1837, described as "revised and enlarged", had an unmodified account of liver structure, but the plates included as fig. 24 "a plan of two lobules of the liver, showing the plexiform arrangement of the duct within them".[75] [See figure 3].

Mayo's fourth edition, also published in 1837, included some rather crude representations of Kiernan's illustrations; his text, too, was based on that of Kiernan, describing both Kiernan's techniques and his major findings, but succeeding in putting a personal touch to the account . . . "This discovery [of the vascular arrangement of the lobule] Mr Kiernan showed me, when as yet he had advanced no further; and I recollect the facts seemed to me equally new, and important, and satisfactory."[76] Müller, in Baly's translation of 1838, acknowledged the "very valuable researches of Mr Kiernan", but he also challenged him . . .

> the commonly received opinion that all the blood of the liver . . . is poured into one and the same capillary system, would, according to Kiernan's view, be incorrect; but his opinion is not yet satisfactorily confirmed, and it is opposed to what we can observe in the injected preparations of Lieberkühn, in which the injected matter is seen to have frequently passed into the same network as readily from the one as from the other vessel . . . Kiernan gives the following description of the mode of termination of the biliary ducts; the minute divisions of the ducts which lie between the lobules divide and subdivide into numerous branches, which at last anastomose with each other, he says, and form a plexus which is independent of that of the blood vessels, and constitutes the proper substance of the lobule. I have not been able to satisfy myself of the existence of anastomoses between the biliary ducts in the instances in which I have injected them; the minute canals appeared to me to terminate in short panicle-like tufts which lay closely inter woven together . . . this excellent inquirer would not have advanced such an opinion if he had examined with the microscope the biliary canals in the embryo of the bird . . . after repeated examination with the microscope, no doubt exists in my mind as to the mode of termination of the ducts in the embryo.[77]

This well constructed criticism contrasts with the unqualified acceptance of Kiernan's work by Mayo, who included his own diagram to illustrate the structure of the lobule, asking "But what is the structure of each lobule? The following diagram is intended to illustrate it. . ."[78]

Mayo's illustration, though, and the accompanying description are a

But what is the structure of each lobule? The following diagram is intended to illustrate it.

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The large circumferential vessel is supposed to be a terminal branch of the portal vein environing a lobule. Branches from it are represented as passing through the lobule, and terminating in the central intralobular vein. The figure, however, is strictly a diagram; in place of a few large vessels *there* represented, in nature there are innumerable capillaries. The vessels in the figure, which are dotted, stand for the commencements of the biliary system. The initial hepatic ducts are a network of fine tubes, of infinite number and reticular complication, involved with, and interposed among the intralobular capillaries.

Figure 4.
H Mayo - *Outlines of human physiology.*
London: Renshaw & Churchill, 4ed, 1837.
Page 112.

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good example of an attempt to explain a complex structure by means of a simple diagram rather than attempting to make an exact representation of the structure as seen with the microscope [see figure 4].

The illustrations in Quain's fourth edition were made under the direction of William James Erasmus Wilson (1809-1884). Wilson had attended Abernethy's lectures at St Bartholomew's, and in 1827 and in 1830 had enriched his medical education in Paris. He was one of the first students at the Aldersgate School of Medicine and he worked with Lawrence, Jones Quain and Kiernan[79]. His ability as a dissector and as an artist had attracted attention, and, having become both a licentiate of the Society of Apothecaries and a member of the Royal College of Surgeons by the time he was twenty two, he was invited by Jones Quain, in 1831, to join him and his brother Richard at University College, as an assistant in the Anatomy and Physiology department. At University College he supervised students in the dissecting room and prepared specimens and drawings. When Jones Quain resigned his post in 1836, Wilson, together with Marshall Hall and Dalrymple, established Sydenham College, a school of anatomy, which survived only for a short time. In 1840, he became lecturer in Anatomy and Physiology at the Middlesex Hospital.[80] In the preface of Quain's fourth edition the author said . . "for the illustrations I am indebted to Mr W J E Wilson. The preparations from which the drawings in the first two plates were taken were altogether made by him; likewise directed their execution, as well as he various sketches for the woodcuts throughout the book"[81]. It was Erasmus Wilson whom Todd invited to write the entry on Liver in his *Cyclopaedia*.[82] This detailed account of both normal and abnormal anatomy of the liver, included numerous references, beginning with early seventeenth century workers, and concluding with contemporary sources including Meckel[83], Müller[84], and Kiernan[85].

A new text to appear in 1839 was Carpenter's *Principles of General and Comparative Physiology*[86]. William Benjamin Carpenter [1813-1885] had entered University College in 1833, the year in which Kiernan's paper was published. He obtained his Surgeon's and Apothecary's Diplomas in 1835 and then went to the Medical School in Edinburgh and began there his researches in physiology. His biographer, Bettany, said that "he wrote papers which showed a marked tendency to seek large generalisations and to bring all the natural sciences to the elucidation of vital functions", and also that his text was " the first English book which contained adequate conceptions of the science of biology. A second edition was called for in 1841, and it was recognised that the author was a man of no ordinary mental grasp and range of study."[87] Carpenter, together with Martin Barry and John Goodsir was one of the students of John Knox. Jacyna considered that Knox's chief importance was as a teacher who assembled around him a school of students whom he steered toward a structural approach to physiology. Some of these, he pointed out, remained in Edinburgh where they established a thriving centre of histological research in the 1840s, while others such as Carpenter, went to London where they strengthened the tendency towards microscopical research fostered at King's College by Todd and Bowman.[88] Jacyna saw Carpenter as an especially interesting member of this group, since Carpenter, while not an important researcher himself, acted as the channel through which the work of the school was made available to a wider audience. Jacyna was not as generous as Bettany, describing Carpenter as "an industrious plagiarist" and recounting how Carpenter transferred the results of front line workers from the proceedings of the London and Edinburgh Royal Societies and other learned journals, to a series of popular texts aimed at medical students[89]. A consequence of this was that Carpenter's texts provided a fair indication of the state of histological research in Britain in the 1840s and 1850s. Carpenter did not deny his sources. In the preface to his *Principles* he stated that the work was especially intended as an introduction to the study of human physiology for the use of medical students, but that he had kept in view the wants of the general reader. His desire to keep the volume generally acceptable both in size and price, he said, had compelled him unwillingly to omit the greater number of references he had designed to introduce. He listed, however, the systematic treatises on whose authority he had usually relied, including the recent editions of Bostock, Mayo, Müller translated by Baly, Todd's *Cyclopædia*, and Edwards translated by Hodgkin and Fisher. He also added that "The author has freely availed himself, also, of the liberal permission of the Editors of *The British and Foreign Medical Review* to make what use he deemed proper of his contributions to that Journal."[90] His text was a mixture of animal and plant physiology, and sweeping statements such as that on the primary tissues of animals . . . "all the tissues now described are formed, more or less evidently, upon the basis of cellular structure"[91] were given the same degree of authority as his account of "Electricity in Vegetables"[92]. In his account of liver, he quoted Kiernan briefly and reproduced his drawing of liver lobules. His text went to a second edition in 1841 and was described as being intended as an introduction to the study of Human Physiology, and as a guide to the philosophical pursuit of Natural History[93]. This volume had additions and alterations, especially on the formation of tissues "on which obscure subject, the researches of Schwann, Schleiden, and others have shed an entirely new light." Liver was considered under 'Secretion in Animals'. The work of Kiernan was again quoted but Carpenter adopted the views of Erasmus Wilson, "in whose careful analysis and excellent illustrations, the Author feels bound to confide", on circulation.[94] Wilson's essay in Todd's *Cyclopædia* had recently been published and had undoubtedly impressed Carpenter, so much so that he stated that he had relied too implicitly on Müller's authority in the first edition.

By 1842, Carpenter had, he said, hoped to see a new physiology text written specifically for the student, since the previously existing treatises were becoming antiquated, but, since nothing had appeared which he considered sufficiently elevated in its character to represent the present condition of physiological science, and sufficiently compendious in its bulk for the limited time at the disposal of most students, he had produced *Principles of Human Physiology*[95]. He claimed that his new treatise was complete in itself, and quite independent of his earlier texts. On this occasion he claimed not to have derived his material from existing systematic treatises, but had "endeavoured to bring together the valuable facts and principles, scattered through the best of the numerous monographs."[96] He defended his method, and said that he felt himself to be more than a mere compiler, and considered that even the well-read physiologist would find in it many facts and deductions, which had not been previously brought before them in the same form.[97] In his account of the minute structure of liver, though, he appeared to have forsaken Wilson, whose name appeared but once, and remarked that "for our present knowledge of their ultimate arrangement, we are almost entirely indebted to Mr Kiernan, whose account will be followed here." In the second edition, which was published in 1844, he related that "the application of the microscope to the hepatic cells, in various states of disease, has afforded many facts of great interest. He then quoted Bowman's paper on fatty liver, printed in the *Medical Gazette* in 1842[98], and that of Williams in the *Guy's Hospital Reports* of 1843[99]. A third edition followed in 1846[100], in the preface of which he acknowledged his debt to James Paget, whose *Reports on the Progress of Anatomy and Physiology*[101] appeared in the *British and Foreign Medical Review*, hastening to add that he had consulted the original sources of information referred to by Paget, in every instance in which he could gain access to them. He also made special reference to the *Anatomical and Pathological Observations*[102] of Messrs Goodsir, which had appeared since his previous edition. He failed, however, to give any authority for his criticism of the cell theory. He said . . ."that all the animal tissues are in the first instance developed from Cells, was the doctrine put forth by Schwann, who first attempted to generalise on the subject. By subsequent research, however, it has been shown that this statement was too hasty; and that, although many tissues retain their original cellular type, and many more are evidently generated from Cells, and are subsequently metamorphosed, there are some, in which no other cell-agency can be traced, than that concerned in the preparation of the plastic material."[103] Of Kiernan's work on the liver he is more positive . . .

> For our present knowledge of their ultimate arrangement, we are almost entirely indebted to Mr Kiernan, whose account of them will be followed here, - his researches having been confirmed, in all essential particulars, by other anatomists.[104]

He added to his section of the diseased states of the liver, that Williams' observations had been confirmed by Dr G Budd, but gave no reference.

Carpenter's listing of Bostock's *An Elementary System of Physiology,* as one of the authorities upon which he relied would probably not have extended to the fourth edition of the work, which was published in 1844.[105]. Bostock had clearly revised very little of his text, which still quoted Hodgkin's observations as being recent, and said that the globular structure of tissues, which had been so fully made out and minutely examined, was now to be seen as deceptive, and that the fibre was to be considered as the most minute component part of the cellular membrane[106]. He did, however, add a footnote on Kiernan's investigations, which he said "must be regarded as an admirable specimen of anatomical and physiological investigation . . . as far as anatomical structure is concerned . . . appear to be most complete and satisfactory."[107] His views on the use of the microscope, were less sanguine

> I am not aware we owe it [the microscope] any further obligations, and notwithstanding all the boasted improvements of modern times, I do not clearly perceive that we have yet advanced much beyond Leeuwenhoek and Hooke, in our power of discriminating minute objects.[108]

Bostock had no good reason to say this, since in Britain at that time the availability of good achromatic microscopes was as widespread as on the Continent for research, although no systematic instruction in their use was available either to the student or the practitioner. In any case, published work relying on the use of the microscope was abundant!

Todd and Bowman at King's College.

The text of Todd and Bowman, *The Physiological Anatomy and Physiology of Man*[109], was designed as a textbook to accompany the lectures on General Anatomy and Physiology, given by the authors at King's College. It was begun in 1843, and the term *Physiological,* in the title had been adopted, the reader was told, in preference to *General,* or the later one of *Histological,* as being more comprehensive than either.[110] The first volume was published in 1845, but the work was not completed until 1856. The authors had, they said, aimed at resting their anatomical descriptions upon their own investigations, but they had to admit that, to the immense extension of the sciences of anatomy and physiology over the period of the book's preparation, their own work was but a small contribution. They also felt that had they been able to devote their time to the cultivation of science, the book would have been completed long before; as it was, increasing interruptions "incident to a professional life", and a large demand made on them by studies of a practical kind, had impeded their progress.[111] They acknowledged the co-operation of Dr Beale, who, by the time the text was complete, had taken over from Todd and Bowman as Professor of Physiology at King's College.

Todd had been appointed to the newly established chair of physiology and general and morbid anatomy in King's College in 1836, having, in 1833, obtained the Oxford degree of MD and having become a licentiate of the Royal College of Physicians. Hernshaw[112] described Todd as a born organiser and pioneer, endowed with boundless energy and enthusiasm. Todd's enthusiasm was to lead to the resuscitation of the medical department at King's, where the numbers had fallen in 1835 to forty two, but had risen to one hundred and thirty by 1843.[113] His obiturist in *The Lancet*[114], writing more than twenty years later said, with hindsight, that

> lectures on physiology were at that time a novelty in the London Schools; but the attraction which Dr Todd's course offered to the student soon compelled their adoption in other institutions. Not only was the method of treatment new, but many of the subjects themselves were novel; for it was at this period that the microscope first began to display the minutiae of structure hitherto disregarded, and to alter and correct the notions which had been formed respecting the functions of the several organs. Dr Todd was always foremost in this race of investigation, convinced as he was that no true physiological conclusions could be drawn without the most ultimate acquaintance with the structure of all the parts of the human body.

Such an eulogy could lead one to believe that at King's, at that period, students were using microscopes in their day to day work. This was not the case, as the Council Minute Book[115] recorded:-

> 24 February 1837. An application from Dr Todd, Professor of Physiology, representing the urgent necessity for making certain additions to the college microscope, the expense of which would amount to the sum of £20. 15s. and it appearing from the report of the professors of Chemistry, Comparative Anatomy and Materia Medica that the said additions would greatly increase its value and usefulness . . .

Thus it appears that only one microscope was available to facilitate the delivery of the course offered by Todd. The King's College Calendar for that year announced that the course comprised -

> 1. Lectures and Demonstrations on the General and Morbid Anatomy of the tissues and organs of the Human Body. 2. An extended Course of Physiology. The whole is illustrated by recent dissections, by preparations, and drawings of parts of Human and Comparative Anatomy, by experiments, and by microscopical observations.[116]

Todd's insistence that the understanding of physiology was based on a thorough knowledge of general anatomy was demonstrated by the questions he set in the examination for the gold medal in physiology and general anatomy in 1837. All four questions required the student to describe anatomical features to support physiological phenomena: for example; "What is the received opinion at the present day as to the source of the biliary secretion? And give the *anatomical* arguments which favour this."[117] Beale, who had been his student was in a position to comment[118] on Todd's teaching skills:

> As a Lecturer on Physiology, Dr Todd was accurate and clear in his statements, and excited the interest of his pupils in what he had to teach. He had a happy knack of putting before his hearers the broad essential points of a question, and keeping the attention directed to these, not by repeating what he had said already, but by recurring to the main facts from time to time, and using these for illustrating new points. His language was good and his manner quiet and deliberate, without ever being tedious.

Beale also painted a picture of Todd as an innovator, describing him as a man who was ever moving onwards. Some people thought Todd too fond of change, but, commented Beale . . ."the development of new work and new thought necessitates new workrooms and great expence, new modes of teaching and generations of teachers different from the former school."[119] Beale went on . . ." after lecturing with great success for twelve years, at his express desire, his friend and coadjutor, William Bowman, was associated with him as co-professor in the year 1848."[120]

William Bowman [1816-1892] had been apprenticed, in 1832, to Joseph Hodgson, a surgeon at the Birmingham General Hospital and had gone to King's College Hospital as a student in 1837.[121] Richard Partridge had also been a pupil of Hodgson, and had supported Bowman's application to King's. Thomas has described how the Principal of King's College wrote to Partridge

> the account which you give of Wm. Bowman is such as to make him a very desirable

> inmate of the College. His being a Dissenter will create no difficulty . . . It is only a question of whether he himself will object to attending Chapel on Sundays . . .[122]

Both Thomas, and Bowman's biographer in Plarr's *Lives,* record that he was appointed Demonstrator of Anatomy and Curator of the Museum at King's in 1839. Thomas[123] said that Bowman first worked as assistant to John Simon, who was Partridge's prosector, and only after Simon became a demonstrator in 1838, did Bowman become prosector to the physiology lectures and in consequence come to work closely with Todd. The Minute Books[124] reveal that in 1839 both Simon and Bowman were appointed demonstrators for the 1839-1840 session, Bowman having been appointed to his post in the museum in the previous March.[125] Bowman's obiturist in *The British Medical Journal* recounts that as a demonstrator he

> studied with the microscope the finer structure of the tissues. The microscopes of those days were clumsy things compared with those of today; and those made in England, with their complex arrangements for stage movements and adjustments, were inordinately expensive . . . he introduced foreign instruments, which were less complicated and cheaper, and while studying histology himself, he taught the students.[126]

It is significant that the minute of a meeting of the Council in December 1842 recorded that the sum of £21 was granted for the purchase of microscopes required in the medical department.[127] Bowman produced, during his time as assistant to Todd, a number of accounts of the histology of the human body: his paper to the Royal Society 'On the minute structure and movements of voluntary muscle'[128] was read in 1840; for this work he was elected FRS in 1841. D'Arcy Power, Bowman's biographer in the *Dictionary of National Biography,* observed that Bowman's work divided itself sharply into two periods - one of pure scientific investigation, the other concerned with the practice of ophthalmic surgery. It was in the former period, between the years 1839 and 1842 that his histological work on muscle, kidney and liver was undertaken. D'Arcy Power described Bowman as "the father of general anatomy in England".[129] Bowman, however, having carried out very significant histological investigations, abandoned the teaching of the subject as his private practice increased and his clinical duties at the hospital became more onerous.

The joint work of Todd and Bowman, *The Physiological Anatomy and Physiology of Man,* was described by Thomas as "the first physiological book in which the histology of the parts was accurately described, and in all cases function was related to anatomical structure - the essential basis of understanding in physiology."[130] This statement is true, in that the authors set out to construct a text to accompany a physiology course, based on the understanding of minute structure. Other workers such as Mandl, in France, had produced illustrated tomes, describing the histology of the tissues. The chapter on liver in Mandl's *Anatomie Microscopique*[131] traced both in text and in accompanying plates, the development of the understanding of the structure of the organ from Müller and Kiernan in the early 1830s to Henle and Bowman himself in the 1840s. Bowman's paper, 'Observations on the minute anatomy of fatty degeneration of the liver'[132], had been published in *The Lancet* in January 1842, and reproduced in *The Microscopic Journal and Structural Record,* and had earned him the Royal Medal of the College of Surgeons. In his paper Bowman had pointed out that his findings were

> an admirable example of the kind and degree of insight into pathological changes, which the microscope is calculated to afford. It is happily unnecessary, in the present day, to come forward as the advocate of this valuable instrument as an aid to the study of disease.[133]

He reiterated Kiernan's description of the vascular element of the lobules of the liver, and agreed with Henle, Purkinje and Schwann that "the small, irregular, angular particles, each containing a circular or oval nucleus", which contained globules of fatty matter, corresponded to the epithelium found in other true glands and that these were the secretory elements. He confessed, however, that "it must be allowed that we are still ignorant of the precise anatomy of the ultimate ramifications of the biliary ducts."[134] Todd and Bowman's text, begun a year after Bowman's work on liver was, they said, intended to furnish the student and practitioner with a plain and accurate view if the intimate structure and functions of the human body.[135] In the 'Advertisement', which prefaced the first volume, speaking of the microscope, the authors said that . .

> the great improvements which modern opticians have accomplished, not only in the dioptric but also the mechanical adjustments of this instrument, render it an invaluable adjuvant in physiological research . . . to make microscopical observations really beneficial to physiological science, it should be done by those who possess two requisites: an *eye*, which practice has rendered familiar with genuine appearances as contrasted with those produced by the various abberations . . . and a *mind*, capable of detecting sources of fallacy, and the understanding of changes which manipulation, chemical reagents, and other disturbing causes may produce in the arrangements of the elementary parts of the various textures.[136]

The cell, as the simplest and most elementary organic form, was made clear, and the work of Schleiden and Schwann acknowledged.[137] The authors said that they found it difficult to devise a satisfactory arrangement of the tissues, based on one principle of classification, and so constructed a table[138] which presented the reader with a general view of the various tissues, the anatomical characters of which would be discussed in the body of the text:

1. Simple membrane, homogeneous, or nearly so, employed alone, or in the formation of compound membranes. e.g. Sarcolemma of muscle.
2. Filamentous tissues, the elements of which are real or apparent filaments. e.g. White and yellow fibrous tissues.
3. Compound membranes, composed of simple membrane, and a layer of cells, of various forms (epithelium or epidermis). e.g. Mucous membrane; skin; true or secreting glands.
4. Tissues which retain the primitive cellular structure as their permanent character. e.g. Adipose tissue; cartilage.
5. Sclerous or hard tissue. e.g. Bone; teeth.
6. Compound tissues. a) Composed of tubes of homogeneous membrane, containing a peculiar substance.e.g. Muscle; nerve.
   b) Composed of white fibrous tissues and cartilage. e.g. Fibrocartilage.

The section on liver did not appear until the second volume of the text was published in 1856, by which time further work on the histology of the organ had been carried out and the professional status of both Todd and Bowman had changed. The work was illustrated by Bowman whose drawings were made directly on the block without the intervention of an artist.[139]

In June 1848, the minutes of the Education Committee[140] of King's College record, a letter was read on the subject of the appointment of Mr William Bowman to the Chair of Physiology in conjunction with Dr. Todd. This, it seems was at the instigation of Todd.[141] The Council resolved to appoint Bowman, but with the distinct understanding that Todd would lecture from October to Christmas, and Bowman from Christmas to the end of the winter session, and that Bowman should "continue to hold the appointment of assistant surgeon to the hospital, subject to the continuance of his connection with the College."[142] Beale recorded that Todd and Bowman took different parts of the course, with Bowman teaching minute structure.[143]

It was undoubtedly Bowman who fostered the histological work at King's. Six months after his appointment to the Chair, he sought more money for the purchase of a microscope: . . .

> a letter was received from Professor Bowman, stating that some of the students in his class were willing to contribute £10 towards the purchase of a Microscope, to be placed in the museum for the use of themselves and such other of the Students of Physiology as should, from time to time, contribute either to the purchase of the instrument itself, or of the necessary microscopical specimens. Professor Bowman earnestly requested the Council to grant the sum of £15 to complete the purchase money. The Council, although of the opinion that it was highly desirable to carry out this proposal, did not approve the proposed details of the plan - but resolved themselves to purchase the Microscope for the sum of £25 - to place it in one of the windows of the Museum of Anatomy, under the care of the Curator - and to grant its use for the purposes of study to any medical student on payment of 2s6d for the Academic Year.[144]

Todd's skills meanwhile were employed not only in his teaching and writing on physiology, but also in clinical teaching, being described by Beale as "one of the most popular clinical teachers of his day"[145]. He had, too, an extensive private practice and was physician to King's College Hospital. He concerned himself with medical education at King's, promoting the appointment of medical tutors and the collegiate system for medical students. He was instrumental in obtaining the foundation of medical scholarships at King's College, and in establishing a sisterhood for the training and employment of nurses.[146] Todd continued in his role as physician and teacher until, in 1853, when, "compelled by increasing practise"[147], he gave up the remaining half of his professorial chair. He continued with his clinical duties until 1859, resigning those just six weeks before he died, at the age of fifty one.

Todd had made every attempt to render the medical teaching at King's more efficient. He had objected to increasing the number of lectures, but had urged the importance of making the teaching more direct in its character . . . "so that the student might be encouraged to see and observe and think for himself."[148] In his resignation address[149] he had spoken of the great advance made in the science of physiological anatomy during his sixteen years at King's, an advance made possible, he held, by the improvement in the microscope . . .

> Not very long antecedent to the year 1836, the attention of many anatomists in this country and on the continent was directed to the use of the microscope in the investigation of minute structure . . . with the improved construction of the instruments there sprang into activity a host of observers, who quickly changed the face of science . . . in that space of time the science of minute or microscopical anatomy has almost been created . . . there is scarcely a tissue or organ of the body of which the teacher cannot describe and demonstrate the anatomy in the most satisfactory manner.

Todd, though, set a precedent in the London schools in giving up the teaching of microscopical anatomy when at the peak of his powers. He claimed, in his resignation address, that he had experienced many impediments in the performance of the duties of his chair, from engagements he could not reject or put aside, and that the time had come when it became his duty to withdraw from a post involving great responsibilities and demanding for the efficient discharge of the obligations it imposed a large expenditure of time and strength. Only Sharpey, in this period, made the teaching of general anatomy and physiology his sole occupation, and, when the advances in practical physiology and histology became too demanding for him alone to communicate to his students, an additional post was created in his department to satisfy the need [see page 226 below] .

Todd was not the only member of the medical faculty of King's College to promote the value of the microscope. In his introductory lecture[150] at the beginning of the medical session 1849-1850, Arthur Farre, the son of J R Farre, in his capacity of Dean for that year, bemoaned the slowness of the profession in general to admit the microscope as a legitimate means of investigation, but, he said,

> every new discovery in minute anatomy added to our stock of knowledge, in a field hitherto uncultivated for any useful purpose, the voice of opposition became so rapidly silenced, that in the course of a few years it has literally died away[151]

He felt that the turning point of this change hinged upon the formation of the Microscopical Society, founded by a member of the medical profession. Farre believed that the microscope would prove to be the most powerful auxiliary that had been afforded to medical research. He encouraged the students to "search out and unravel by this new aid the intricacies of our organism"[152] and to examine it in health and disease. He added that it had "pleased the almighty Author of nature to permit us to penetrate, and there to regale our delighted vision with new proofs of his omnipotence".[153]

Todd had, in his introductory lecture for the session 1852-1853, been able to announce that an additional, extra-collegiate laboratory had been established by Dr Beale, for microscopical researches in connection with clinical medicine. In the published account of the lecture he was able to add that Beale had announced "a course of six practical demonstrations, chemical and microscopical, on subjects of the utmost importance in connexion with the investigation of disease, and which every advanced student will find it his interest to avail himself."[154] A year later W A Guy, the Dean, in his introductory address had been able to report that Beale's appointment as Todd's successor to the Chair of Physiology, jointly with Bowman, would not deprive the College of "this most useful addition to our means of practical instruction".[155]

Bowman had been asked by the Council to take over Todd's half of the chair, but had declined the offer, partly because increasing engagements precluded him from devoting more time to physiology, and also because

> the science has such wide connexions, and is now so rapidly progressive that doubts may be entertained whether it can long continue to be taught by a single professor if he be at the same time engaged in active practice.[156]

He added that he wished to remain attached to the hospital and continue his clinical teaching there and would place his half of the chair at the disposal of the Council. [The rule that the role of professor should always be attached to the post of physician to the hospital had been rescinded on Todd's retirement to enable him to carry on his clinical work.] The Education Committee decided to recommend to the Council that Bowman be asked to keep his half of the chair for three more years, to elect someone jointly, and after three years the new person would be asked to take full responsibility.[157]

A special committee composed of Dr Watson., J H Green, and W R Riddell, with Sir Benjamin Brodie as chairman, was set up to consider this recommendation and also to consider Todd's proposal that the subject of morbid anatomy should be separated from the chair of physiology and general and morbid anatomy. The principal of the College, Dr Jelf, wrote to the committee, putting forward his views, and the opinions of the medical professors were also sought, and entered in the minute book.[158] Todd's proposal was not considered but there was considerable debate about the expediency of dividing the chair between two professors. Bowman was again asked to take the whole chair, but he still refused, stating that the division of the chair could be well worked if a suitable person could be found. He felt that the arrangement had enabled both Todd and himself to devote more time to the work and that it was especially necessary to get men engaged in practical work. Some professors supported this view, especially as it ensured that Bowman would continue with his teaching, others felt that a divided chair would possibly attract only inferior men. Partridge felt that it was inexpedient to divide the chair and pointed out that if the principle was allowed, professors would virtually appoint their own successors, because no man would be appointed that the old professor did not like. There was amongst the medical professors a unanimous wish that whether the post be for a whole or a half chair it should be advertised.

Dr Jelf felt that of all the subjects taught in the college, physiology was the one which required the most delicate handling . . ."every thing depends upon the *spirit* in which it is treated. It may be made a vehicle for scepticism, disguised or undisguised, or else be turned to the glory of Almighty God". He recommended that no powers, no acquirements, no plausibility, no facility in lecturing should outweigh the one grand question - "is the man in life and conscience, as well as in profession, a good Christian man, a sincere member of the Church of England ?"[159] He knew, he said, a physiologist of sufficient piety for the post and recommended his appointment. Hearnshaw records that the Council, while thoroughly concurring in Dr Jelf's principles and thanking him for his recommendation, decided to advertise the chair in the usual way, confident in their ability to detect sceptics, even if disguised, and to exclude doubtful characters, however plausible.[160]

Beale's Appointment.

The post was advertised as Joint Professor of Physiology and of General and Morbid Anatomy in April 1853[161]. The details of the post indicated that each professor would take half the course, and that Bowman would take whichever part he preferred and would generally direct the system to be pursued, but that the person elected would have to be prepared to undertake the entire duties of the professorship after three years, when Bowman would resign. There were six candidates: Dr Beale and Dr Brinton, who were both connected with King's; and Dr Black, Dr Heale, Dr Salter and Mr T H Huxley. In his letter of application[162] Lionel Smith Beale [1828-1906], who had been both a pupil at King's College School and a student in the Medical College, said that he had "very early acquired a taste for physiological chemistry and for minute anatomy". He pointed out that he had, while assisting Todd and Bowman at King's, and assisting Dr Acland in the Museum at Oxford, much practise in putting up anatomical preparations, and preparing minute dissections, and microscopical specimens, and also in making dissections for illustrating physiological lectures. Within the last year, he reminded the Council, he had been enabled to establish a laboratory and rooms in Carey Street, for the prosecution of microscopical investigation and physiological chemistry . . . since

> delivering my first lecture in November last, upwards of eighty gentlemen have entered the course of lectures on the microscope and animal chemistry - this number includes more than fifty medical practitioners, some of whom are examiners at Apothecaries Hall, and others, physicians or surgeons to hospitals.

He stated his progressively important roles in the hospital, first as out-patient dresser, then clinical clerk and currently as house physician and finally stressed his membership of the Church of England. Beale was twenty six years old when he applied for the post of Professor, and he provided testimonials from some eminent men, including Carpenter, Parkes, Acland, James Paget, Richard Quain, John Quekett and Handfield Jones. Carpenter, examiner for the University of London, where Beale had been a candidate for the MB degree, referred to Beale's reputation as a microscopical anatomist and bore testimony to the "great excellence" of his examination paper on physiology and comparative anatomy, "this having not been surpassed, either on that or any other occasion within my experience for comprehensiveness and accuracy of knowledge, and for clearness and method in its exposition." Paget, then assistant surgeon and lecturer in physiology at St Bartholomew's Hospital, spoke of his reputation and his zeal, while Quekett, resident conservator and professor of histology at the Royal College of Surgeons, declared . . .

> that he is fully conversant with the use of the microscope and its application to the investigation of natural and morbid structures is well known to me and can be borne testimony to by those who have so recently attended his admirable course of lectures.

Richard Quain, as secretary to the Pathological Society, remarked that Beale had on several occasions brought before the society morbid specimens, illustrated by microscopical and chemical observations and drawings. Others reported upon his skills as a lecturer[163]. The Council was obviously concerned that Beale was more interested in physiological chemistry than in anatomy and physiology, and Brodie had written to Acland[164] for clarification. Acland supported Beale, saying that when he, Acland, had applied to King's College for an *anatomical* assistant, Beale had been selected, and was already an accomplished anatomist. He stated that Beale had only *become* a physiological chemist because he had pursued this work in the hospital where he had found it necessary to push his physiological analysis on into the domain of physiological chemistry.[165]

On Monday the 2nd of May 1853, the committee met, together with Bowman, to examine the applications[166]. The minutes record that after much discussion the names, in alphabetical order, of Beale, Brinton, Huxley and Salter were selected and upon closer investigation those of Beale and Brinton were further selected as being in the opinion of the committee the best qualified for the post. Some of the medical professors were to be asked by the Principal, individually and separately, to comment on the candidates' merits, having been shown the application forms and testimonials. They were not, however, allowed to comment as a body. The minutes record that the replies were read, as was the correspondence with Acland and that Beale was selected.[167]

Hearnshaw recorded in 1928, in his centenary history of the college, and with the benefit of hindsight, that from among the applicants four were selected by the committee as possessing that harmonious combination of science and religion so necessary for the "delicate handling" of physiological truth in the college. One of the four he said, was Thomas Henry Huxley, aged only twenty eight, but already an FRS . . . that he was not the candidate finally chosen must not be regarded as any slur upon either his orthodoxy or his efficiency. His successful rival, Lionel S Beale, had over him the immense advantage of being an old student of the college, a member of the medical staff, and an assistant physician to the hospital. Professor Beale had, he said, proved to be an eminently sound and safe physiologist; but in spite of his great and faithful services to the college, one could not feel but a certain regret that Professor Huxley was not appointed. If he had been appointed, he went on, and had remained on the staff until Dr Wace's time, what powerful allies they might have been in the struggle against agnosticism![168] Hearnshaw is less than generous to Beale in these comments, and also to Brinton, who was a demonstrator in anatomy at King's at the time of his application, but went on to succeed Grainger as Professor at St Thomas's in 1861.

Beale lost no time, following his appointment, in bringing his classes at his laboratory in Carey Street into the regular courses of the college. The Council agreed to include his course in the prospectus provided Beale himself paid for any special advertisements, printing and the expenses of the laboratory.[169] The syllabus for the Physiology and General and Morbid Anatomy course had remained virtually unchanged from the time when it was established on Todd's appointment. The main mode of teaching was by lectures and demonstrations . . . "the whole being illustrated by recent dissections, by preparations and drawings of parts of human and comparative anatomy, by experiment and by microscopical observations."[170] The examination questions, though, show that recent histological investigation was incorporated into the course, not only in physiology but in medicine and in pathology. In the examination papers for physiology in 1842-1843, three out of the twelve were concerned with general anatomy. Todd's questions were simple and invited a broad answer, for example - "Describe the various forms of epithelium." In the same year Professor Budd, in his examination paper on medicine asked more structured questions, for example - "What are the chemical and microscopical characters of pus? How may pus be distinguished from mucus", and in the scholarship examination on Medical pathology - "Describe the general appearance and the microscopic characters of the fatty liver. In what diseases is it almost exclusively met with? To what symptoms does it give rise?"[171]

It is interesting to note that in the King's College Calendar for 1843-1844, the examination questions set at University College in the previous session were also printed. They provide an interesting contrast. In the two papers on Anatomy and Physiology from University College, half of the questions in the first paper were concerned with general anatomy, which reflected Professor Sharpey's interests; for example - "Describe the structure and mode of growth of epithelium, giving examples of its several varieties. Describe, in particular the ciliated epithelium, with the form, structure, arrangement and motion of the cilia. What reasons can be adduced for or against the opinion that the ciliary motion is due to muscular contractility?"[172]

Sharpey at University College.

Sharpey's teaching at University College has been well documented by Taylor[173], and a more intimate account of his methods has been revealed in

Jacyna's analysis of Sharpey's correspondence with Thomson[174]. In Sharpey's obituary notice in the *Proceedings of The Royal Society of London,* which was written by Thomson, it is recorded that he never

> wrote out his lectures, excepting an introductory one, and he delivered them all without assistance from writing beyond very short jottings on small slips of paper. He made use of diagrams and pictorial illustrations as well as of anatomical preparations and physiological experiments, and was one of the first to introduce the employment of the microscope for the practical illustration of his lectures.[175]

E A Schäfer, one of Sharpey's most distinguished pupils, who later added Sharpey's name to his own, described Sharpey as

> one who knew how to impress the facts which he taught upon the minds of his hearers; and this without any parade of oratory but by plain statements in clear language with just sufficient iteration to emphasise the main points of the subject.[176]

A significant amount of original material survives which demonstrates the nature of his lectures and demonstrations, but, as Taylor points out,[177] Sharpey's record of original published work is meagre and his influence was not that of a great research worker gradually building up a school. Taylor added that Thomson had cited Sharpey's lectures as the medium whereby he communicated much original research and thought.[178] This statement could be considered as rather generous!

Taylor identified five sets of manuscript lecture notes, taken from Sharpey's lectures between 1836 and 1867: those of Potter, in 1836-7; an anonymous student, in 1837-8; Ballard, in 1840-41; Lister, in 1849-50; and of Thane, in 1867-8. Research for this present thesis has revealed the existence of three further sets of notes: those of Clover, in 1845-6; Wishaw in 1855; and of Tupp in 1860. These form a series and show how Sharpey modified and enriched his lectures in the light of new discoveries, of the developing understanding of the cell and of the structure of the tissues as revealed by the microscope. Lawrence has pointed out that lecture notes reflect an interaction between the instructor and the student, and that they are neither sources for what the lecturer necessarily said or did, nor accounts of what the student understood, but an amalgam of statements and interpretations.[179] While this no doubt is true, such a wealth of material relating to Sharpey remains extant that a fair picture can be drawn both of his methods and of the content of his teaching.

That a collection of drawings and paintings formed an important aid to teaching is revealed not only in Sharpey's letters but also in a series of manuscript booklets[180] in which he listed such drawings, together with recommended texts and lists of specimens required for specific lectures. In book four of this series which lists his requirements for the session 1837-1838, the list for the opening lecture, on 4th October, includes the text of Quain, under the heading 'Anatomy'; those of Bichat, Béclard, Grainger and Craigie, under the heading 'General Anatomy'; and those of Müller, Elliotson, Bostock, Mayo and Majendie, under the heading 'Physiology'. The list for the following day includes a summary of the 'Order of the Lectures', presumably to be written up on a board before the lecture, since such a list appears in student notes.[181] The order of teaching was obviously modified in a subsequent year, alterations showing that after having described the characters of animals and their tissues, Sharpey replaced his teaching of the blood system with that of the organs of digestion as his third section. His third lecture was given over to the arrangement of the tissues, that of Bichat, of Dupuytren and Richerand, and of Sharpey himself. The booklet also contained master drawings in colour, ready to be copied onto the board.

Book seven, for the session of 1838-1839, by which time Sharpey would have had time to develop his resources, has a list of reference books for each section of the course, and diagrams in four groups: those worked in oil; those in water colour; those to be put on the board; and those on calico. By 1838 he had included the first part of Quain's *Anatomy* under his 'General Anatomy' heading, and that of Carpenter under 'Physiology'. In that year Sharpey lectured on the liver in December . He used a variety of drawings to illustrate this lecture including three taken from Kiernan's paper in *Philosophical Transactions,* which, together with pages 447-452 of Müller's *Physiology* he noted as his key reference work on the minute structure of liver.

That Sharpey had to work hard to develop his course and his collection of illustrations after he was appointed to University College is clear from his letter of 2nd December 1836 to Thomson[182] . . .

> But oh I find such a great quarry of a place by no means so convenient for the daily preparation of lectures, and it will take some time before I get well organised. I have a young man engaged to draw for me, he makes the sketches on the board, copies them afterward into a book, and enlarges them and renders them permanent at his leisure. I have introduced the oil painting but we are at a loss about some points on which I must beg the favour of you to write to me *most particularly* and in any other you may think useful. How is the canvas prepared? Is it done over with size or anything to prevent sinking before the ground is put on ? How is the ground or indeed the colours generally rendered dull (not to shine)? How are they made to dry speedily? How long should a man take to paint such a thing say as the large oil painting of the Eye or Ear? . . . .We are sometimes at a loss in what colours to represent objects in the pictures.

Sharpey also had to buy many of his own books . . ." I am ruining myself buying books, and mean to have a complete set of the French and German periodicals which are more immediately connected with my subject." Unlike Todd and Bowman, and later Beale, at King's, Sharpey did not have at this time a text he used as a class book. To Thomson he wrote . . .

> I feel the greatest difficulty in recommending a text book for physiology. The only extent to which I at present see any prospect of myself being able to supply the deficiency is in so far as it concerns General and Physiological Anatomy - Müller if *well* done into English shall be my textbook for Physiology next year.

Sharpey had told Thomson that Baly was translating Müller's text, but that he feared that it would require much "draping" to make it presentable to English readers.[183]

That Sharpey was one of the first to use the microscope for demonstrations in London is clear. Thomson claimed that Sharpey's use of a microscope mounted upon a revolving table was "the first attempt made in London to illustrate physiological work microscopically"[184], and Jacyna has identified discussion between Sharpey and Thomson in their letters about the design of suitable microscopes for this purpose.[185] Foster, a pupil of Sharpey in 1850 said that "All he did by way of practical teaching was to show us the microscope preparations of the various tissues."[186] Starling, in his Centenary Address at University College in 1927, recorded that "in the Physiology Department we still possess the oval table at which he sat with his senior students and passed round the microscopic specimens so that each man could see them for himself under the microscope"[187]. The table had a hole in the centre and a brass strip let in near the circumference. An iron bar was placed in the centre hole carrying an arm, at the end of which was a microscope, which could be revolved on the brass strip. The table is still in one of the common rooms of the department today, with its central hole filled, but with the brass strip, with the impression made by the travelling microscope still intact.

The 'plan of instruction' to be followed by Sharpey had been agreed by the medical faculty in July 1836, and stated . . .

> the class at two o'clock to be especially devoted to general or structural anatomy and physiology. It will consist of a complete account of the anatomy of textures, development of organs, and physiology, more complete and extensive than formerly, to be given by the new professor, along with so much descriptive anatomy as is required for the elucidation of those subjects . . .[188].

An undated manuscript,[189] in Sharpey's hand, possibly from his Edinburgh teaching days, of notes for an introductory lecture demonstrates his own approach to this task . . .

> it has lately become the fashion to commence an anatomical course by describing the general properties of the materials which compose the body - this is named general anatomy - and is significant in respect both to physiology and pathology and ought therefore to be carefully explained to you . . . in the same way I will connect the details of general anatomy with the particular description of the organs . .

Sharpey's introductory lecture for his first session at University College was reported in *The Lancet*[190]. In this he defined the term 'general anatomy' as "all that relates to the *tissues* of which the animal frame is made up . . . the intimate structure, or texture of organs". He went on to say that

> on this account it has a very direct relation to physiology; for the most important vital processes are carried on in the intimate texture of parts . . . we cannot hope to become acquainted with the true nature of the actions until the structure is known in which they take place.[191]

Sharpey also pointed out that general anatomy was the

> department of science . . . most directly connected with pathology, or the study of disease. As every texture of the body possesses characteristic properties, which it retains, under certain modifications, in all the diversified organs in which it is found, so its diseased affections are marked by certain common characters, in whatever organ it happens to be affected[192].

Sharpey maintained that the study of morbid, or pathological anatomy, was the surest guide to correct discrimination and rational treatment of diseases, and hence the study of healthy structure, upon which that of morbid structure depended, was important.[193]

Sharpey spoke too of the use of the microscope in the study of general anatomy, and said that the judicious use of the instrument had greatly advanced the subject. He maintained that the objection to its use, that observations were liable to fallacy, could only be applied to cases where very high magnifying powers were used, and that such were seldom required. In short, he said, the objections to the use of the microscope were as nothing in the scale, when weighed with its advantages.[194] Sharpey commended his lectures to his students, pointing out that they would be constantly illustrated by dissections and preparations, together with the additional illustration of small or intricate parts by enlarged drawings, which he pointed out, enabled the lecturer to first point out the facts that he then intended to show on the real object, and enabled the student more easily to understand the preparation when he came to examine it. This demonstration of objects aided by drawings could, he felt, be used more than it currently was. However . . .

> The principal facts relative to the textures . . . can be seen only by means of the microscope . . . some microscopic objects which do not need to be highly magnified, may be shown even during the lecture; and a time may be set apart for demonstrating those which require a higher magnifying power, or nicer manipulation. An opportunity is thus afforded of practising the student in the use of the microscope, with which, in the present state of science, no accomplished anatomist ought to be wholly unacquainted.[195]

Sharpey was not, therefore, simply amongst the first to use the microscope to illustrate his lectures on general anatomy, but he incorporated its use, together with his illustrations, into an excellent teaching strategy. This undoubtedly contributed, together with his warm personality, towards his reputation as a great teacher.

A detailed account of the content of Sharpey's lectures for his first session at University College[196] has survived in the form of notes, taken down verbatim, by John Phillips Potter[1818-1847]. Potter had entered University College as a student in 1831, had become a pupil of Richard Quain in 1835-36 and had obtained the highest class honours in the session 1836-7. He went on to take the BM degree of the University of London in 1841 and acted as a demonstrator in Anatomy at University College from 1843. He was said to have been an excellent teacher. He became assistant surgeon to the North London Hospital in 1847 and died in that year following an operating wound.[197] It is not surprising therefore that such a complete set of notes was taken and preserved for future use by Potter.

Sharpey had begun immediately with general anatomy . . . "we now enter a very important part of our course, a consideration of the characteristics of the constituent tissues of the body, forming that division of anatomy called *General Anatomy*"[198]. There followed a detailed account of the chemical constituents of the body and the general anatomy of the tissues, the study of the latter being, said Sharpey, comparatively modern. The work of Malpighi, Ruysch, Carmichel Smith and of Pinel was mentioned and Bichat's classification of the tissues into twenty one groups was tabulated. Sharpey pointed out that succeeding anatomists such as Richerand and Dupuytren were not satisfied with Bichat's classification and had reduced the number of elementary tissues to eleven. Finally Sharpey produced a classification of tissues which he proposed to follow in the succeeding lectures . . .

> not that I consider it to present any particular merit, but rather because I look upon it as a matter of indifference; for as the physical and vital properties of these tissues interest us more as medical men than their origin, it will not much signify if we have a few more elements than in strictness we should enumerate.[199]

Sharpey's list included fifteen tissues: cellular; fibrous; elastic; muscle; blood vessels, including erectile tissue; absorbent vessels and glands; nervous; cartilaginous; fibrocartilaginous; bone; serous and synovial membranes; mucous membranes; skin and dermoid; cuticular - hair and nails; and secreting glands. Sharpey then showed his students specimens of each of the different tissues he had listed, using fresh veal to demonstrate his lecture. The next twenty four lectures were devoted to the description of each of the tissues in turn. He illustrated his lectures with diagrams and also with microscope slides . . ."now here is a small specimen (under the microscope) of cellular tissue, beautifully injected by the successful Lieberkühn nearly a century ago. This beautiful specimen shows you an appearance highly vascular . . ."[200] A small drawing of this specimen was included in the notes, the form and labelling of which suggest that a coloured drawing had been put up to assist the students in the examination of the specimen under the microscope. Sharpey's frequent reference to other workers is well illustrated in his lecture on cellular tissue. He referred to the views of Bordeu, Wolff, and Meckel, who, he said, rejected the idea of cells, filaments or laminae, and declared that it [cellular tissue] was only a viscid, tenacious, homogenous substance like birdlime or glue. He contrasted this with the view of Jordan and that of Milne Edwards . . .

> Milne Edwards of Paris supposed that the fibres were composed of minute globules arranged in linear order like a string of beads. He did not I think use recent specimens. He had his own theory to support and he would not be singular under the circumstances in looking at the experiments with a rather prejudiced eye. Indeed I am afraid it is too much the case with observers of this kind, *to see what they* believe, rather than to believe what they can *see.*[201]

It is remarkable that no mention was made of the improvement in the optics of the microscope, or of the work of Hodgkin and Lister almost a decade earlier. Later in the session, introducing his students to the structure of the organs of secretion, Sharpey pointed out that although glands agree in many essential points, still they differ in many respects . . . "thus though the liver and kidney are formed on the general plan or principle of structure, they are unalike one another in many anatomical details"[202]. He referred his students to the work of Müller on the structure of glands. Sharpey did not like the use of the word 'acini' , which he felt had led to much confusion . . .

> if you tear a piece of parotid gland or liver, you see (smaller than the lobes or lobuli) a number of little vesicular looking bodies united together like a bunch of grapes. These are termed by some the acini. Others again apply the term to the commencement of the ducts, and here is the cause of confusion, the same term being applied to different parts of a gland.[203]

He also felt that the term 'conglomerating gland' was confusing and proposed to discard these imprecise terms. In his general anatomy lectures, which occupied half the course, Sharpey described the structure of glands in general terms only and it was not until he turned to special anatomy and physiology that he introduced the structure of the liver to his students. Having described its gross anatomy he referred them to Kiernan's paper. Throughout his lecture he referred to the terms used by Kiernan, equating the 'acini' of some anatomists to Kiernan's 'lobule', the term he then continued to use to describe the granular structures of which the liver was constructed. Several diagrams from Kiernan's paper in *Philosophical Transactions* were used to illustrate his lecture, including those of two lobules of liver, with their interlobular ducts, and the cross section of lobules showing interlobular veins and the lobular venous plexus, that had been reproduced in the leading texts of the period.[204]

Sharpey's teaching technique is again demonstrated by his reiteration of the principal points of his lecture on the following day, and his further observation that although Müller was aware of Kiernan's discoveries and view's on the liver, he, Müller, did not entirely agree with the account, being of the opinion that the ducts commenced in the lobules by simple branches with closed extremities, whereas Kiernan described them as beginning by a network of reticulated vessels on the outer part of the lobule. Müller, Sharpey said, had arrived at his conclusion from examining the vessels in the lower animals[205]. In a letter to Thomson in December 1836, Sharpey reported that he had

> got through general anatomy, to which I devoted a pretty long allowance of the course, and am so far with the particular functions. I describe carefully the organs concerned, especially as regards the internal structure, but I see clearly that my course will be very free of mere descriptive anatomy ... the course will be one of physical and physiological anatomy - to compound small things with great on the plan of the Elementa of Haller.[206]

The rather scrappy notes entitled "Epitome of Physiology - Doctor Sharpy", made in the session 1837-1838, appear, as the title suggests, to be a condensed form of Sharpey's lectures by an unknown student[207]. They contain a number of page references, presumably to a recommended text, but no drawings except tiny sketches incorporated in the body of the notes. Several questions are posed in the notes which suggests that this manuscript may have been compiled for revision purposes.

The only published account of Sharpey's lectures, other that his initial introductory lecture in 1836, was that which appeared in *The Lancet* in October 1840[208]. The first five lectures were reported in full and in the first Sharpey gave a clear description of his understanding of the term 'general anatomy'.

> . . .the textures of each part are made up of something that is not confined to particular organs, but is spread generally over the body, or is common to many organs; and it has been termed *general* anatomy. I do not mean to say that these are the best or most appropriate terms that could be employed, but they have been in use ever since the time of the illustrious Bichat, whose genius and labours tended so much to advance the study of anatomy.

He went on to illustrate how general anatomy would be investigated, using bone as an example . . .

> in studying the general anatomy of bone . . . it is a matter of indifference whether we take the thigh bone or a piece of the skull; the same texture is common to all bones; it is something general . . . examine it with a microscope to detect its minute structure . . . search into its chemical composition . . . thus we learn the common structure of all bones, and in doing so we should be studying general anatomy.[209]

He told his students that the study of general anatomy would occupy a large part of the course, and that he would begin with the tissues and then go on to examine the anatomy of the different organs. In his second lecture he recommended Quain's text on anatomy, the first part of which, he said, was devoted to general anatomy; and the texts of Bichat, and Grainger amongst others, although these were "less up to the present state of the science". For physiology he recommended Müller, the translation of which had just been completed, and which was he said, the only work with which he was acquainted that contained a sufficiently full statement of the present state of knowledge on physiology; together with Bostock's text "for the learning it contains, and its references to other books"[210]. He had not changed the arrangement of his lectures from previous years, he said, but there would be considerable alteration to detail, since physiology and minute anatomy were progressing with great rapidity[211].

The editors of the *Medical Times* had tried to obtain reports of Sharpey's lectures in response to requests from readers, but had failed to gain his cooperation in this venture. They reported that "we are forced to disappoint our friends on the head of Dr. Sharpey's lectures. We have gone to considerable expence in securing a correct report of his present course, and the first of the series is actually in type, but having learned from the worthy lecturer that he is strongly opposed to all publication of his lectures - a sense of delicacy wins from us an immediate acquiescence in wishes which, while we consider sacred, we cannot - less on our own account than that of the public - but deeply deplore."[212]

Notes of Sharpey's lectures in the year, 1840-1841, were, however, taken by Edward Ballard, and are still extant, having been given by Ballard to University College. A covering letter, dated May 27, 1891, which accompanied the two volumes of notes, stated that he took the notes himself when a student and that they "are nearly verbatim as the lectures were delivered. All are full and complete and very clearly and legibly written"[213]. It is in these notes that Sharpey's use of the word 'histology' is first found. In his introduction to that part of the course he said "General Anatomy has been called *Histology*"[214] and he then proceeded to give the classification of Bichat, of Dupuytren and Richerand and then his own division of the tissues. The work of Schleiden and Schwann was reported . . ." Schwann . . . found that all the tissues arise from the simple cell."[215] The notes show that each of the tissues was dealt with in a systematic manner, with the structure, apparent and microscopical, being described for each. The anatomy of the liver was dealt with in the second part of the course, details of its gross anatomy, minute anatomy and physiology being woven together. Once again the views of Kiernan and Müller on the origin of the ducts are described but Sharpey did not express an opinion.[216]

Edward Ballard applied in 1844, by which time he had graduated MD from the University of London, to undertake the duty of a private tutor to the students in the medical faculty. Members of the medical faculty, at their meeting of June 21, 1844, expressed themselves "satisfied of the usefulness and importance of private tuition as an assistance to students in their progress and think it highly expedient to make a cautious trial of it on a limited scale during the coming session." A committee, which included Sharpey, was set up to report to the Council and to frame regulations under which a system of private tuition could be conducted.[217] There were several well known private tutors in London at the time, but this appears to be the first time that such tuition, sanctioned by the Council of the College, was offered by a man with up to date information and ideas, to supplement the teaching in the medical faculty.

The notes of J T Clover were taken of some of Sharpey's lectures given in 1845-6,[218] and have not been described before. They show that the use of the term 'cell' was common by this time. In a note on the formation of cells Schwann's description of elongation and splitting of cells was recorded. Lecture sixteen, on the ultimate elements of structure, contained a list of how cells may change; these included: growth; alteration of shape; uniting with others; contents alter; matter may get in and out; disappear; generate new ones. Nothing remains of Clover's notes on specific tissues or organs.

The notes of Joseph Lister [1827-1912], on the other hand, are more detailed.[219] They were written in the session 1849-1850, and have many additions, mostly dated 1852, and initialled by Lister, indicating that he attended the series of lectures for a second time. Lister had a distinct advantage over his fellow students in that his father J J Lister furnished him with a good achromatic microscope of his own. This microscope is now in the Wellcome Collection at the Science Museum, London.[221]

Lister took an active part in the affairs of the Medical Society at University College, and read a paper before the society on the use of the microscope in medicine. No record of this can be found, but Godlee said that the paper led to much difference of opinion, some holding that the employment of the microscope would sound the death knell of accurate clinical observation.[222]

Sharpey-Schafer recorded that William Sharpey was beyond doubt the man who exercised most influence over the young Lister. He pointed out that at the time when Lister began his medical studies, Sharpey was in the full vigour of his teaching career, and that Lister had said "as a student at University College I was greatly attracted by Dr Sharpey's lectures, which inspired me with a love of physiology that has never left me" and that after speaking of having been equipped by his father with a first-rate achromatic microscope, had added "I employed it with keen interest in verifying the details of histology brought before us by our great master."[223] Indeed Lister's first research was histological, his paper on the muscular tissue of the iris and that on the small muscles of the hairs being published in the *Quarterly Journal of Microscopical Science* in 1853.[224] It was not the influence of Sharpey, though, that promoted Lister's work on the eye, but that of Thomas Wharton Jones [1808 - 1891], who was professor of ophthalmic medicine and surgery at University College. Wharton Jones was said to have "peculiar manners, an outrageously Scotch accent, and modest and retiring disposition"[225]. Sharpey did not like Wharton Jones, as a reference to him as a "cankered little cat" in a letter to Thomson suggests![226]

Lister's notes of 1849-50 contain many references to current works, including that of Henle and of Todd and Bowman, and also to Sharpey's own experiments and confirmation of the work of others in the field. The notes were not taken down verbatim but were written with a clear understanding of their meaning. The list of recommended books had been updated to include the works of Kirkes, Paget, Carpenter, and of Todd and Bowman. The order of lectures had changed so that after the general section on characteristics of animals, and on the chemical and physical properties of the body, a 'history of blood' was considered, prior to the examination of the tissues of the body. Liver was included in the large section headed 'Organs and functions of digestion' In the section on general anatomy, the cellular, filamentous or areolar tissue was recorded as being sometimes called 'connecting tissue'. The list of seventeen kinds of tissue ended with 'secreting glands', and the comment "absurd to speak of glandular tissue, as the different glands differ, but yet possess certain common principles of construction."[227] The features of cells noted by Clover were repeated - the last now reading "cells may give rise to a new cell"[228]. A clear description of a cell was given and the views of Schleiden on the nucleus and his term 'cytoblast' recorded. The section on the cell is lengthy, but does not purport to supply all the answers. Lister's notes give a flavour of Sharpey's style . . .

> Cells may be produced whenever there is blastema . . . but how is the nucleus

> formed? Uncertain. Schleiden and Schwann say nucleoli first appear in the blastema, how arising we know not, than the matter of the blastema appears to be aggregated by some attractive power to the nucleoli.[229]

Sharpey had told Thomson in 1842 that he had undertaken to superintend certain portions of a new edition of Quain's *Anatomy*, and that he found it no easy task, as the general anatomy needed to be rewritten[230]. The first part of the new edition was published in 1843[231], and the finished, two volume work in 1848, with Sharpey and Richard Quain as editors.[232] In the 'advertisement' of the first part, it was stated that " the department of General Anatomy having made great advances within the last few years, it has been thought best to write anew the part of the work devoted to that subject. This has been undertaken by Dr Sharpey . . . ".[233] In the introduction to the work Sharpey observed that the term 'general anatomy' had been objected to, and "the term 'histology' (ἱστὸς, a web), itself not free from objection, proposed in its stead: there seems no sufficient reason for the substitution . . ."[234] Sharpey went on to enumerate the tissues and to remind his readers that they were not to be regarded as simple structural elements, and that the distinction between textures and organs had not been strictly attended to by anatomists. He pointed out that if he were to separate every tissue into the simplest parts which possessed assignable form, he would resolve the whole into a very few constructive elements[235]. These he reduced to

> *simple fibre, homogeneous membrane,* either spread out or forming the walls of cells, and *globules* or *granules* varying in diameter from 1/12000 to the 1/6000 of an inch. These, with a quantity of *amorphous matter*, homogeneous or molecular, might be said, by their varied combinations, to make up the different kinds of structure which we recognise as tissues . . .[236]

The words of the text follow quite closely those of the lecture notes made by Ballard and by Clover, referred to above. The structure of the cell was described and the views of Schleiden and Schwann on formation of cells described in detail.[237] It is clear that Sharpey sought the help of junior members in his department in preparing the new edition. In a letter to Thomson he said that a young man had taken notes of his lectures as a basis, had then incorporated something more from sources he had indicated, and then he, Sharpey had put the manuscript into its final shape.[238] In the 'advertisement' to the 1848 edition, by which time all the sections had been revised, the editors thanked Mr Ellis, the late Mr Potter, and Mr Marshall, for their help. It was John Marshall [1818- 1890] who was then a demonstrator in anatomy at University College, who was particularly thanked . . . "the notes of his lectures have, for the most part, served as a basis"[239] John Marshall went on to publish his own *Textbook of Physiology*[240], which Sharpey-Schafer said was also largely based on notes from Sharpey's lectures.[241]

The section on liver in Sharpey and Quain's fifth edition of *Elements of Anatomy* was in the second volume which appeared in 1848. The gross and minute structure of the organ were considered together, the structure of glandular tissue, in general, having been considered under the heading of 'general anatomy' in the first volume. Kiernan's work was repeated in detail, together with the diagrams which had illustrated Kiernan's paper in *Phil. Trans.* in 1833. Müller's view of the structure, which coincided with that of Kiernan was also discussed. [Müller's text, translated by Baly, was now available]. The various views regarding the commencement of the biliary ducts were reported, and the views of Henle, Theile, and Krukenberg, contrasted with those of Kiernan . . .

> according to Mr Kiernan the biliary ducts commence within the lobules by numerous ramifications, which form a closed network of plexus . . . it is conceived by Krukenberg and Theile that the interstices between the network of capillary blood-vessels in the lobules represent the reticular ducts of Kiernan . . . it has been put forward by Henle, Müller and others, that the nucleated cells lie in linear series between the vessels, and for the most part present a similar radiated arrangement from the centre towards the margin of the lobules[242]

Sharpey and Quain did not, though, on the subject of liver, express any view based on their own observations.

The editors of the *British and Foreign Medico-Chirurgical Review*[243] expressed a strong view, however, on the length of time it had taken the editors to produce the new edition, and particularly took them to task for allowing five years to elapse between the production of the first and final parts of the text . . .

> Valuable as we deem the introduction on General Anatomy contributed by Dr

> Sharpey, and greatly as we admire the comprehensive knowledge and cautious observation which it evinces, we cannot find in it the evidence of any such originality of research, as might fairly require five years for its completion, - the author's labours not having been productive of new results on more than one or two subjects of importance.[244]

They did however concede that they had no hesitation in pronouncing the work on general anatomy to be "the most complete, and at the same time concise, view of the subject that has yet appeared".[245] They, the editors of the *Review*, declared themselves unable to discern on what principle the tissues were arranged. This is hardly surprising since Sharpey had admitted to Thomson that he could have offered a classification of the textures, but that "at present it is all guess work . . . in my lectures I am in the habit of giving a classification at the *end* when the relations can be made more intelligible"[246]. In this new edition, though Sharpey had taken the opportunity of including a new series of drawings, which the *Review* applauded.[247]

Sharpey's letters were not solely concerned with his own work at University College. They included comment on the welfare of other teaching establishments. In 1842 he had reported that his own student numbers were falling, but that the College was in no worse a position than other large schools, such as Guy's and St. Bartholomew's. The smaller schools, he said, were in a bad position, with "Aldersgate nearly knocked up - Webb Street . . just given up in the course of the summer and St Thomas's . . . have scarcely more pupils than they have got of lecturers"[248].

St Thomas's Hospital Medical School

St Thomas's had not flourished since its separation from Guy's. It had, though, been recognised by the new University of London as a school from which it would receive certificates for the purpose of graduation, at a time when Solly was appointed lecturer on physiology and comparative anatomy, and Travers jun. and Le Gros Clark, together with Mackmurdo, as probationary lecturers in anatomy and physiology.[249] A special meeting of the lecturers was held in January 1842 to discuss the state of the medical school.[250] They felt that those schools connected with a *College* had become formidable rivals to the older establishments, which depended on their connection with a hospital. Their own situation was due in part, they thought, to there being two schools in the vicinity, to the incessant changes in teachers, and to the current teachers not having the confidence of the public, being deficient in name and popularity. The lecturers, in February 1842, had indicated their wish to resign, as a body, and the Treasurer suggested that a special sub-committee of the Grand Committee should be established to consider what steps should be taken thereafter.[251] Initially a reunion of Guy's and St Thomas's, and the establishment of a College, on the plan of King's was recommended. The treasurer of Guy's was, however, opposed to such a union.

The physicians and surgeons of St Thomas's made a number of proposals in a report to the sub-committee[252]. They felt that the appointment of lecturers of acknowledged talent was of prime importance, but that if anyone should be appointed from outside the hospital, arrangements should be so managed as to avoid any "separation of interests" between the teachers and the medical officers. 'Interests' of this kind were clearly financial, since until this time all lecturing had been done by officers of the hospital, and any 'separation', whereby other than the physicians and surgeons taught the students, would mean a loss of income and a siphoning of funds from the hospital to the school. They recommended, however, that there should be no change in the lectureships "unless following the examples of leading Schools in London we recommend the division of Anatomy into Practical and Descriptive Anatomy and General Anatomy and Physiology"[253]. They also recommended the appointment of a curator to the museum, who would also model and draw, together with an assistant and a librarian. Their final recommendation was that a second lecture room was needed. It was also pointed out by the officers that the emoluments derived from pupil fees were no longer adequate remuneration for the time, labour and expence for undertaking the responsibility for teaching.

In July 1842 Richard Grainger was appointed lecturer on General Anatomy and Physiology at £200p.a. and a third of the students' fees. He closed the school in Webb Street, and St Thomas's took over his perpetual pupils. Grainger had to bind himself not to lecture on general anatomy or physiology other than at St Thomas's for three years and to use all his exertions to promote the interests of its school.[254] This step immediately improved not only the teaching staff, but also the student numbers for that year. Other posts were distributed amongst the existing staff, and Thomas Hodgkin, having been passed over for a post at Guy's, became a lecturer in Medicine, with Dr Barker. A committee of lecturers was set up to advise the Grand Committee on both the arrangements for the school and for the museum. The cost to the officers of undertaking a teaching commitment was raised again in the following year, when it is clear that funds for running the school were very difficult to obtain from the treasurer, and that the lecturers felt that unless some action was taken there would be little to

> induce them to continue their labours . . . if the amounts so received are anything but the semblance of remuneration for the time employed, and which taken as it is in many cases from the most important part of the day, necessarily deprives the Professional Man of considerable emolument he might otherwise obtain . . . remember that all expense actually improves the Hospital's own property.

The Grand Committee was reminded that the museum was not "a mere receptacle of unmeaning curiosities but is preeminently calculated to subserve the interest of the Patients themselves" and should therefore be supported by hospital funds.[255]

In the 1843-1844 session George Rainey was appointed as an assistant in the museum, at a salary of £100 p.a.. He was employed to make preparations for the museum, and more particularly those necessary for the illustration of the lectures[256]. In December 1843 Grainger reported to the Committee of Lecturers that

> the mode of conducting the anatomical department in the present day requires minute preparations illustrative of structure and function . . . the museum possesses such a collection of preparations which can only be examined with the aid of the microscope . . . hitherto individuals connected with the school have kindly provided them an assistance not always to be depended on . . . these considerations render it desirable that a microscope be provided for the use of the museum and that for the purchase of the instrument it be recommended that £40 be granted.[257]

It is not clear whether this particular request was not granted or whether it merely took time to process, but at the end of that session, in August 1844, the Medical School Committee resolved that

> on the recommendation of the lecturers that a suitable microscope be purchased for the use of the museum and that the Committee of Lecturers in conjunction with the treasurer of the hospital be authorised to lay out a sum not exceeding £50 in the purchase.[258]

Rainey's job was modified at the same time to include the preparation of minute healthy and morbid, and comparative anatomy preparations.[259] This was in contrast to the position at University College where, at this time, Sharpey was regularly using microscopical preparations to illustrate his general anatomy lectures. The expenditure sheet in the Medical School Committee report for 1844 -1845 included that for an achromatic microscope at £52.10s, together with a microscopic lens, drawing paper and preparations purchased from the College of Surgeons for £70. 8s.[260] Considerable effort was expended in the preparation of a catalogue of the museum, to which Grainger and Rainey contributed the section on microscopical anatomy. Access to the single microscope appears to have been carefully guarded, since in January 1847, Rainey put in a request that he should be furnished with a key to the microscope and also the microscopical cabinet.[261] Rainey was, at this time referred to as the microscopical demonstrator. By 1849 the position seems to have changed but little, with

> the microscopical preparations and microscope . . . under the supervision of Mr Grainger and Mr Simon; and in the immediate charge of Mr Rainey . . . the microscope room be used only by those using the microscope or writing the catalogue and when so engaged[262].

By this time Rainey had been promoted to demonstrator of anatomy[263]. A letter from him, dated June 1850, gives an account of his duties. These included:

> demonstrating in the dissecting room daily in winter; demonstrating each week in the theatre; microscopic demonstration once a week and preparing preparations for it; contribution of some preparations to the microscopic cabinet illustrative of such subjects as I have been especially investigating . . .[264]

In March 1851 Rainey asked permission to use, during the summer months, the small dissecting room adjoining and looking into the dissecting room, a room "appropriated to Mr Rainey's use during the winter for the purpose of giving some practical instructions and demonstrations on the use of the microscope".[265] The treasurer requested a more explicit opinion on Rainey's request, and the Committee of Lecturers, which then included Green, Grainger, Barker and Simon, said that the proposed demonstrations would be advantageous to the school and that it was desirable that permission be granted.[266] The treasurer agreed to the proposal provided it did not affect the running of the school. In the *St. Thomas's Hospital Gazette*, Parsons described Rainey in the context of this workroom. . .

> a dissecting-room small, as we should think to-day, with its quaint hanging-room (scarcely more than a glorified balcony) at one end, where the little, bald-headed man sat, surrounded by his microscopes and complicated injecting apparatus, and added each day a little more to his store of knowledge.[267]

In 1853, Grainger asked for assistance in giving his course of lectures "in consequence of his official engagements in the present critical state of public health". He had received offers of help from Rainey, Bristowe, demonstrator in morbid anatomy, and from Brinton, lecturer in forensic medicine. Grainger had no hesitation in recommending that Rainey should assist him, he, Grainger, not knowing any man in Europe who was more distinguished or had more merit and originality as a physiologist.[268] The Committee did not necessarily, it seems, share that view, since, having called Rainey in and explained "the position as regards the emolument in which it was probable that he might be placed if elected to the chair of physiology", Rainey withdrew his application.[269] Whether the Committee did not regard Rainey as having sufficient stature to enhance the reputation of the school, or whether, without a successful private practice or a clinical appointment, he would have received little income is not clear. Parsons records, though, that Rainey was a good researcher, demonstrator and teacher, "at lecturing he was a complete failure. he was too diffident, too learned, and too honest to make a good lecturer."[270]

The qualities of Bristowe and Brinton were discussed, and while the Committee acknowledged that Bristowe had been one of their most distinguished students, "from Dr Brinton's longer standing as a physiologist . . . the interests of the school will be best served by recommending that Dr

Brinton should be appointed to take a portion of Mr Grainger's lectures"[271]. William Brinton [1823-1867] was, in 1854 appointed joint lecturer with Grainger, and on Grainger's retirement succeeded him to the chair of physiology. Meanwhile Rainey continued as demonstrator and a second microscope was ordered for the start of the 1855 session, following a complaint from students about the difficulties they experienced in gaining access to the microscope. This instrument was placed in the library, for easy access, and its purchase was said to "extend the present system of scientific investigation"[272].

There had been a succession of men responsible for the work on morbid anatomy at St Thomas's. Initially, in 1845, it had been considered "inexpedient and unnecessary to appoint any lecturer on that subject"[273]. In March 1846, however, Dr George Johnson was appointed to a lectureship on pathology, a post which included acting as demonstrator on morbid anatomy and superintendent of the pathology department of the museum.[274] In September of that year Johnson was replaced by Mr E E Barron, and a year later, in August 1847, Mr John Simon [1816-1904][275] became Lecturer in Anatomical Pathology.[276] One of his duties was to enter into a book the result of any investigations made by means of the microscope. The Dixon prize, which was established in 1852, for the best report on cases of malignant disease, required students to make microscopical examination, and "drawings showing the minute structure of the deposit will increase the value of the description".[277] Granshaw has pointed out the establishment of the prize marked a change in the use of the microscope, the students being expected to employ it for their own education, no longer only when the demonstrator wished to show them something once a week.[278] Microscopical study had in this case become an integral part of the description of the study of pathology.

Hodgkin did not remain at St Thomas's for very long. Following his resignation from Guy's in 1837[279] he had been asked to help in the restructuring of the St Thomas's School. He designed a course on the theory and practice of medicine to be taught by a group of popular teachers, including Marshall Hall and George Gregory.[280] In his introductory lecture to the course in 1842 Hodgkin introduced his new colleagues, including Grainger, and spoke of the recent advances in "our science", in particular those in microscopic anatomy. He referred back to his own work with Lister, and recounted that it was at his, Hodgkin's, suggestion that Lister had investigated the minute structure of animal fluids and solids. He pointed out that the importance of discoveries " which the construction of powerful microscopes has placed it in our power to make in physiology and pathology."[281] Hodgkin also emphasised the special relationship between special, general and morbid anatomy; but it was a lecture that looked more to the past than to the future and it is perhaps not surprising that his name was omitted from the list of lecturers for the session 1843-44. Letters from both Hall and Gregory to Hodgkin at this time, indicate that Hodgkin was not consulted about the changes and had written round to his colleagues in an attempt to discover what was happening.[282] In a second letter Marshall Hall told him that the object of all the arrangements was to raise the standards of the school, and since Hodgkin attracted fewer students to his classes than others he would be asked to resign . . . " it is not for me to advise you what to do, but this I can truly say, that your talents are of an infinitely higher order than those required of a lecturer."[283] Hodgkin resigned and his place was taken by the very men that he had recruited. Gregory was, in contrast, much more forward looking. In his introductory lecture for the 1845-6 session, which he entitled *The Ladder of Medical Learning*[284], he described general anatomy as having,

> within the last few years, advanced greatly in interest and importance from the renewed application of the microscope . . . general or philosophical anatomy is still progressing, and very materially altering the aspects of medical science.

Guy's Hospital Medical School.

When Hodgkin left Guy's in 1837 the teaching of anatomy and physiology was undertaken there by Bransby Cooper and Edward Cock, clinical staff of the hospital. In an article on staff changes in the *Medical Times* in 1843 it was reported that at Guy's "the system of subsidiary education, by which Dr T Williams takes Microscopic Anatomy, and Dr G Bird Physiological Chemistry, is a useful innovation, and a tribute to the requisitions of an improved time, which we did not expect."[285] Golding Bird was succeeded by William Withey

Gull [1816-1890] in 1846, at which time anatomy and physiology were separated, Gull being appointed to the chair of physiology and John Hilton [1805-1878] taking responsibility for anatomy. Gull had been a prize student at Guy's and had graduated MD from London University in 1846. He held the physiology post until 1856, and was also Fullerian Professor of Physiology at the Royal Institution between 1847 and 1849. In 1856 he moved from the teaching of physiology to that of medicine at Guy's. His obiturist in *Guy's Hospital Reports* for 1890 recorded that "as a lecturer Gull was careful, instructive, and interesting, full of impressive aphorisms and ripe conclusions, using apt and striking metaphors, but only sparingly, and enforcing what he taught by a dignified, slow, and careful reiteration, which never wearied, and which it required more than average carelessness to forget"[287]. Gull was also to become a member of the Senate of the University of London, of the General Medical Council, and was to be Censor and Councillor of the Royal College of Physicians, "where his voice was always in favour of science, of investigation, of advance and improvement."[288] Gull's pre-eminence was as a clinician and he had a very successful private practice, but there is evidence that despite the fact that he was not universally liked, he was a good teacher[289]. Notes of Gull's lectures on physiology for the session 1852-3, taken by John Dixon [1832-1930][290] show that Gull espoused vitalism . . .

> inorganic matter becomes vitalised, and *vitalism* expresses a power manifested in living beings and is derived from a parent . . . the atoms of living tissues are arranged in an unstable and, at present inexplicable manner . . . the vital stimuli are air, heat, moisture, food and light."[291]

Throughout the notes there was no reference to actual observation of tissues, although there were references to the observations of microscopical anatomists.

The notes were arranged systematically, and liver appeared under the heading of 'secretion', being described as partly secretive and partly excretive. Gull classified glands both physiologically and anatomically, with liver being listed under both conglomerate and tubular glands. A printed syllabus accompanied the notes, which indicated that the minute anatomy of each system would be considered. That of the liver was, however, only briefly described as being made up of lobules, with hepatic veins running to the centre of each lobule.[292] It is remarkable that no reference was made to the discoveries of workers such as Kiernan, Müller and Bowman, nor was reference made to papers or texts for the further use of the students.

The courses listed in *The Lancet*[293] for the Medical Session at Guy's in 1844-5 and for 1845-6 indicate that Microscopical Anatomy was taught on one morning each week, by the demonstrators, Birkett and Poland; in 1846-7 this was described as the 'Anatomy of Tissues' and was taught by John Birkett, while Gull taught physiology and comparative anatomy; and Hilton, anatomy, descriptive, surgical, and pathological. John Birkett [1815 - 1904], had been apprenticed to Bransby Cooper at Guy's and became a demonstrator in anatomy there in 1837, a post he held for ten years. His biographer records that "he signalised the session 1845-6 by giving demonstrations on microscopic anatomy on certain evenings in the week, and in this way beginning the teaching of histology in the hospital".[294] He later became assistant and then full surgeon to the hospital and lectured in anatomy with Hilton. He was influential in that he was on the Council of the Royal College of Surgeons, from 1867-1883, and became its Vice-President and then President. He was one of the founders of the Pathological Society of London, "doing good work by insisting upon the use of the microscope in the investigation of tumours at a time when such a method was unusual"[295] He was described as a teacher as being slow and uninspiring. Birkett translated von Behr's *Handbook of Human Anatomy, General, Special and Topographical*[296] in 1846.

T B Johnston confirmed that histology was first taught in the anatomy department and recounted that

> the school building, opened in 1826, served its purpose until 1850, when it was decided to build a new dissecting room, and to utilise the old one for the purpose of enlarging the museum . . . two small class rooms were added and one of these was set apart for the purpose of microscopical anatomy. No definite instruction involving the use of the microscope seems to have been given hitherto, apart from the lectures in anatomy. Hence forward the school was proud of the fact that a Lealand and Powell (sic) microscope and several hundred specimens of the various structures of the body, presenting a complete histological series, were available for the use of students. The microscope itself, a massive instrument on a heavy tripod stand with a tube length of 8 inches, now rests from its labours in Guy's museum of antiquities.[297]

This was written in 1925, and the microscope can still be seen in the museum. There seems to have been little link between the teaching of Birkett and Gull.

Wilks recorded that as the study of the minute anatomy of tissues became more important, demonstrations on microscopic anatomy were given by Mr Birkett,

> Histology, as it is now called, was associated with physiology when Dr Pavy succeeded to the chair in 1857. Classes in practical physiology, at which the use of the microscope was taught, were first given in 1871, in compliance with the regulations of the College of Surgeons.[298]

The position of Thomas Williams, referred to in the *Medical Times*, is not clear. Wilks recorded that he had entered Guy's in 1837, and was

> one of the first at Guy's who could be said to have understood the full powers of the microscope. Having grasped the new Cell-doctrine of Schwann, he wrote some capital essays on the subject in the *Guy's Hospital Report*. Dr Williams, being only tutor at Guy's and seeing no opening for any higher position, joined Grainger's school at Webb Street as demonstrator on anatomy. When the school broke up he went back to his native country - South Wales - and commenced practice in Swansea.[299]

Williams died in 1865, at the age of forty six.

His papers, the first on the 'Pathology of Cells'[300] and the second on the 'Physiology of Cells'[301] were published in 1843 and 1846 respectively. The first was intended to form the first of a series of

> reports and observations obtained and accumulated in the Microscopical Department of this hospital; more especially by the examination of *morbid structures*, which the dead house daily affords.[302]

The first was a very detailed account of contemporary work in Britain and on the Continent, including recently published work by Goodsir, Bowman and Barry. He undoubtedly had access to texts and journals and clearly made full use of them. His detailed study of the morbid anatomy of the cells of the liver, he reported, had been undertaken at the request of Dr Addison, who had established a separate ward in the hospital for the investigation of hepatic disease. Williams stated that it was to Addison rather than to Bowman to whom the profession was indebted for adding to the knowledge of fatty degeneration of the liver.[303] His second paper began with a detailed account of the structure and functions of the liver. He commended Grainger's article on 'Glands' in Todd's *Cyclopaedia*[304] but pointed out that it was written before the introduction into physiological science of the cell theory of secretion. It is surprising that with such a paper in his own house journal Gull made no reference to it nor yet included up to date understanding of the structure and function of the liver in his lectures.

There were others at Guy's who became convinced of the usefulness of the microscope, not simply for establishing structure and elucidating function, but as a means of diagnosis. Bransby Cooper, surgeon to the hospital, writing in 1850, said

> I confess it was with difficulty I could bring my mind to believe, that the investigation of the molecular structure of the tissues could ever tend to the advancement of medical science; and it required a struggle to overcome the *vis inertiæ* of my mind, and the stubbornness of ignorance, before I was induced to examine the minute structure of the various tissues of the human body by the aid of a microscope . . . in a very short period I became impressed with the thorough conviction of the utility of the microscope in pathological observations . . . I am now convinced that the microscope is as necessary to the anatomist and pathologist, as the scalpel to the one and bed-side observation to the other.[305]

It is significant that, in its account of the Recognised Medical Institutions, Schools and Teachers, the *Medical Directory* for 1850 made specific mention of the use of the microscope in the various teaching courses. Apart from its use by Grainger at St Thomas's, it was reported that at Charing Cross "microscopical demonstrations are occasionally made by Mr Wharton Jones", while at the Middlesex "the museum is open daily to students, who have opportunities of making examinations with the microscope". It was not just the schools attached to hospitals that were listed as making use of the instrument for demonstration, the Hunterian School of Medicine was, for example, reported as having microscopes and anatomical drawings of the first order.[306]

Charing Cross Hospital Medical School.

Thomas Wharton Jones[307] was, like Bowman, an ophthalmologist, and had a particular interest in minute structure. Wharton Jones, whose long and bitter feud with Sharpey began when they were young men together in Scotland,[308] had received his medical education in Edinburgh, and had been appointed, at the age of nineteen, in 1827, as demonstrator to Robert Knox. He had become involved in the Burke and Hare scandal and had been obliged to leave

Edinburgh, first moving to Glasgow, and then, in 1835, to Ireland, and, in 1837 to Europe where he visited the major universities. Later in 1837 he returned to England and began to practise as an ophthalmic surgeon in London. He was appointed lecturer on physiology at the Charing Cross Hospital in succession to Henry Hancock in 1841, and held the post until 1851 when he was elected Professor of Ophthalmic medicine and Surgery at University College.

Henry Hancock [1809-1880] had lectured on anatomy and physiology at Charing Cross from 1836, two years after the establishment of its medical school, and it was his translation to the chair of surgery in 1841 which left the vacancy filled by Wharton Jones[309]. There is no evidence that Hancock used a microscope to illustrate his lectures, but, as a member of the Council of the Royal College of Surgeons from 1863-1880, and a member of its Court of Examiners from 1870-1871, he played a part in the establishment of histology in the curriculum. [See page 287 below]

Wharton Jones had been elected FRS in 1840, when he was appointed Fullerian Professor in Physiology at the Royal Institution, and in 1850 he was awarded the Astley Cooper prize for his essay on 'The state of the blood - vessels in inflammation as ascertained by experiments, injections and observations under the microscope.' His biographer in *Plarr's Lives* records that he shone greatly as a teacher, and preferred to teach as a man of science whose maxim was 'let us look, let us see.' His influence as a teacher, he noted, was felt in particular by Thomas Henry Huxley, who said of him "from the first I was strongly attracted by Wharton Jones's lectures. Singularly dry and cold in form, they were admirable in logical construction and full of knowledge derived from personal observation and wide reading . . . He never had any notes, but the lectures would have read perfectly well if they had been printed straight off."[310] Minney records that Wharton Jones's influence on Huxley was noticed by the other students, and that at the end of the day, when they were leaving, they were always sure to see young Huxley's dark head bowed over a microscope in the windows of a temporary lecture room on the first floor at the back of Golding Ward. The room, he said, came to be known as 'The sign of the Head and Microscope'. This may have been the case, but Minney's history of the School at Charing Cross[311] is full of inaccuracies and is couched in a very romantic style. His obiturist in the *Lancet*, though, confirmed that, as a teacher, Wharton Jones, whilst repelling the careless or casual student, attracted and encouraged the serious and intelligent one by his earnestness and his contempt for shams and all pretence in knowledge. His method was that of observation, experimentation, and verification.[312] It was this meticulous method which Wharton Jones adopted for his investigation of the liver. His paper[313] was read before the Royal Society in 1848 and was concerned with the microscopical examination of the contents of the hepatic ducts. Wharton Jones said that the existence of hepatic cells in the smaller ducts of the liver threw light on the anatomical relationship of the hepatic cells to the radicles of the hepatic ducts, a point which had not previously been determined by direct anatomical demonstration, although different hypothetical explanations had been offered. He examined two such explanations and showed that his observations supported the one whereby the hepatic cells of which the parenchyma of the liver is composed are pervaded by intercellular passages leading directly into ducts, which having a proper coat were recognisable as such. The hepatic cells, analogous to the endogenous cells of other glands, which formed, like the epithelium, the immediate wall of the intercellular passages, became, in the recognisable ducts, superseded by proper epithelium[314]. Henle had suggested that this theory, demonstrated as fact by Wharton Jones, was most probably correct. Wharton Jones had used the human liver for his investigations, removing the contents of the ducts with small microscopical forceps.[315] He was said to have distrusted artificial means of rendering microscopic appearances clearly visible, hating stains and acids. When Wharton Jones left Charing Cross for University College, his place was taken by Edwin Canton, who was styled Lecturer in General Anatomy and Physiology. Canton, who had been a pupil at the school and demonstrator in the anatomy department at Charing Cross, was also an ophthalmologist.[316]

St George's Hospital Medical School.

At St George's, Blomfield recorded, during the period 1851-9

> **the comparatively small use of the microscope . . . is indicated by the restriction of the use of this instrument at St George's to those students who subscribed to the microscope fund. The microscopes were first placed in the library, but afterwards removed to the museum, in the gallery of which they were long employed.[317]**

There is little evidence that until 1856 the microscope was used for anything other than occasional demonstrations to illustrate the anatomy and physiology lectures. The well-established school adjacent to, but independent of St George's, owned by Samuel Lane, offered classes in anatomy and physiology, which Lane himself, an excellent teacher, taught.[318] *The Lancet,* in its listings for the medical session of 1849-50, indicated that at Lane's "the microscope will be used to illustrate particular subjects in the lectures upon anatomy, chemistry and botany."[319]

St George's own 'Theatre of Anatomy' had been established in a house in Kinnerton Street only since the beginning of the 1837-8 session. Here Thomas Tatum [1802-1879] and Henry James Johnson [1808-1889] lectured in anatomy, physiology and surgical anatomy, while Henry Charles Johnson [1808-1863] and H J Johnson, who were unrelated, supervised the demonstrations and dissections. Both Johnsons were house surgeons at St George's. A set of notes of lectures given by H C Johnson and taken by William Withey Gull in 1840 (although under what circumstances is not clear) contains a very detailed description of the minute but not microscopical structure of the liver, illustrated by water colours made from injected preparations. Johnson had listed Knox's translation of Cloquet's *Anatomy,* Baly's translation of Müller's *Physiology,* and Quain's *Anatomy,* as his recommended texts.[320] A set of lecture notes of H J Johnson's anatomy and physiology lectures for the same year show that he relied strongly on texts, rather than on any original work or practical confirmation of that of others, for his lectures. He divided tissues into the eleven categories of Bichat and outlined six hypotheses for the structure of the 'ultimate fibre'. These included the work of Milne Edwards, of Dutrochet, and of Hodgkin and Lister, but there is no mention of microscopic characteristics in his description of the various tissues[321]. In 1844 the course was divided so that Tatum and H J Johnson taught anatomy, general and physiology, and H C Johnson taught anatomy, descriptive and surgical. In 1846 Dr Charles Handfield Jones took over the teaching of the general anatomy and physiology course, to be replaced by Athol Johnson in 1849.

Charles Handfield Jones [1819-1890] had studied medicine at Cambridge and at St George's. His biographer[323] recounted that in his early career he had devoted himself to research into the minute anatomy of the liver, and for this at the early age of thirty-one, he was elected FRS in 1850. While his investigative work may have had no direct influence on his teaching of general anatomy, it was during his years at St George's that his main research was done. As Chen[324] has pointed out, the major problem for the student of liver structure since Kiernan's work had been the nature of the terminal bile duct system. Just as Wharton Jones was pursuing this problem, Handfield Jones, in his first paper reported that he had investigated "the exact mode in which the biliary ducts take their origin, and the disposition and function of the epithelial cellular element . . ."[325] He contrasted the work of Kiernan, Müller, Weber and Kronenberg, whose views had been confirmed by Paget, in his Report[326] of 1845, with those of Bowman and Henle. Whereas Wharton Jones had examined the contents of the ducts, Handfield Jones compressed a thin section of liver and examined it under the microscope. He concluded that "the cells forming the margin of the lobule are those in which the elaboration of the secretion is perfected, and that as this is effected they burst and discharge their contents into the cavity of the duct" - a view shared by Henle.[327] In his second paper[328] Handfield Jones referred to Williams's work[329] with which he differed in some respects and gave what he thought to be the first description of the structure of the minute branches of the hepatic duct[330]. He also admitted an error on his earlier work, having since become convinced that the membrane investing the lobules was not the basement tissue of the ducts, but a continuation of Glisson's capsule.[331] His third paper was read on January 17 1852[332], by which time Handfield Jones had been elected FRS and had become assistant physician to the newly formed St Mary's Hospital. In it he challenged the existence of the "lobular biliary plexus", this time using injection techniques, and described the termination of the ducts, a description with which Kölliker agreed.[333]

The Other Hospital Medical Schools.

Not all medical schools had men whose specialism was minute anatomy as lecturers in general anatomy and physiology. The courses listed in *The Lancet* at the beginning of each medical session show that there was an increasing separation of the teaching of general anatomy and physiology from descriptive and surgical anatomy. A lecturer for the former course was almost always a young medical man, usually a surgeon, who had trained in the hospital and, on qualifying had become demonstrator in anatomy, then assistant surgeon and lecturer in general anatomy and physiology. After some years, on appointment as full surgeon, he would often become lecturer in surgery. Thus young men were developing their teaching skills whilst lecturing in general anatomy and while becoming better known in their profession and often establishing a private practice. With few exceptions they would have had little opportunity to undertake any investigative work and would have been hard pressed to keep up with developments in the field. This was the case at the Middlesex Hospital, the London, the Westminster and at St Bartholomew's.

The Middlesex Hospital Medical School had been established in 1835 by the efforts of the medical officers, Bell, Tuson, and Mayo, amongst others, who had seen the status of the Middlesex Hospital as a teaching establishment threatened when University College Hospital was built.[334] Bell, who had given the opening address at University College in 1828, also gave that of The Middlesex Hospital School seven years later. In 1828 he had bemoaned the fact that "in the past the temptation of following a lucrative practice had far outweighed the desire of reputation to be gained by teaching", and that men "looked upon teaching as a situation introductory to business, one of expectancy, and to be occupied in rapid succession by young and inexperienced men."[335] In 1835 he failed, not surprisingly, to look to the future, but instead dwelt on the circumstances which had placed the hospital in danger of losing its students. He also emphasised his view, no doubt affected by his experiences at University College, that there should not be two posts of professor and demonstrator. The pupils, he said would be more intimate with the demonstrator than the professor, and would regard the latter as too great a personage to be troubled with questions on anatomical points. Anatomy, he felt, was not to be learned without the constant presence of the teacher, who should put on sleeves and apron and demonstrate as he himself had done.[336]

The staff appointed initially, jointly to teach anatomy and physiology, were well known. Besides Bell there was Tuson, who had been a pupil at the Middlesex and was a surgeon and a popular teacher. He had taught at the Little Windmill Street School. They were joined by Shaw, Bell's brother-in-law, who had worked with him at the Great Windmill Street School. There were, however, early staff changes. Bell accepted the chair of Surgery at The University of Edinburgh in 1836, and the principal part of the Middlesex Hospital Museum, which had remained his personal possession, went with him to Edinburgh. Not only the museum exhibits, but also much of the apparatus and the diagrams used in the teaching of anatomy and physiology, were the property of individuals, as had been the case when William Sharpey had moved to University College. The resignation or death of a member of staff thus deprived the school not only of a teacher but of his teaching materials as well. Shaw resigned in 1839 and Erasmus Wilson was elected in his place. Tuson and Wilson provided some stability and when, in 1845, Tuson resigned, his place was taken by an assistant surgeon Campbell de Morgan [1811-1879].

De Morgan had been a student at University College when Bell was professor there. He lectured in general anatomy and physiology at the Middlesex school from 1847 to 1865. De Morgan was popular, and Home wrote of him "His geniality, his naturalness, his sincerity, his evenness of temper, his gentle dignity, all combined with a very fine presence to captivate everyone.[337] The fact that while at the Middlesex De Morgan lectured in forensic medicine, anatomy and physiology, and, when Shaw left, was the sole lecturer in surgery suggests that his teaching of general anatomy did not carry great authority. In 1845 a special class in pathology and morbid anatomy was established and a lecturer, Dr Seth Thompson, who was an assistant physician, was appointed. In 1846 a new course was advertised, entitled 'The microscope as applied to Chemistry, Physiology and Pathology', to be taught by Mr Day[338]. George Day, a physician, published his course of lectures 'On chemistry and the microscope in relation to practical medicine', having rewritten and modified it for publication. Day described himself as lecturer in animal chemistry and histology at the Middlesex Hospital.[339] In 1849 the school announced that "The museum is open daily to students who have opportunities of making examinations with the microscope".[340]

At the Westminster Hospital School a succession of men taught anatomy and physiology. Malcolm Hilles was a lecturer from 1838 to 1840. He had been an unsuccessful candidate for the post to which Sharpey was appointed at University College in 1836, having been judged by the appointment committee there "not to possess sufficiently high attainments and reputation"[341]. Hilles had been a student in Dublin and had established a private school there, teaching anatomy and physiology with some success. From Westminster he moved first to Sydenham College, which closed at the end of the 1840 -1841 session, and then to the Hunterian School following the death of Mr Dermott, the owner[342]. That Hilles's teaching of general anatomy was not of the highest quality at any of these institutions can be surmised from a review of a small book, *The Essentials of Physiology*, which he published in 1860[343]. The review[344] of this "little pocketful of physiology", while recommending it as an accurate book for students preparing for the physiological examination of the Royal College of Surgeons, and praising it for the inclusion of recent researches, said of the author "he does not allow the great facts of science to be overlaid with microscopic details . . . ".

Following Hilles a series of surgeons and assistant surgeons taught anatomy, physiology and practical anatomy. In the Prospectus for the medical session 1849 -1850,[345] Mr Brooke a surgeon and Mr Hillman, an assistant surgeon, taught the anatomy and physiology course which was described as being "intended to comprise the anatomy and development of the tissues and organs of the body, with their principal morbid changes." The lectures were illustrated by preparations, diagrams, and microscopical demonstrations. It was not until 1854 that physiology and general anatomy was advertised as a separate course, with Hillman, still an assistant surgeon, as the teacher.

Similarly at the London Hospital the surgeons and assistant surgeons, Luke, Adams, and Hamilton taught anatomy and physiology together with operations of surgery, although, unlike the arrangements at the Westminster, a separate course of morbid anatomy was taught by Curling, another surgeon to the hospital. James Luke [1799-1881], who as a student had attended the lectures of Abernethy and Astley Cooper, had been appointed demonstrator in anatomy at The London Hospital in 1821, lecturer on anatomy in 1823 and lecturer on surgery in 1825[346]. In 1841 he devoted himself to surgery and Adams took responsibility for the lectures in anatomy and physiology until 1845. John Adams [1805-1877] had entered the London Hospital as a student, was appointed demonstrator in anatomy in 1828 and subsequently lectured in both anatomy and in surgery. Adams was a member of the Council of the Royal College of Surgeons from 1862 to 1869 and of the Court of Examiners from 1868 to 1872. He was said to have been very popular, both with the staff and with the students, although his classes were not, it appears well controlled. His biographer recounts that "when as was usual, a disturbance arose in his class, he used suddenly to bring down his fist like a sledge-hammer upon the table and shout 'if you don't stop this bloody row I will close the lecture'."[347] In 1845 the *Lancet*[348] recorded that William Carpenter was to lecture in anatomy and physiology, while Adams continued to teach descriptive and surgical anatomy.

In 1846 the Associated Lecturers at the London changed their title to The Medical Council. The minutes of that body record that in that year Dr Parker was permitted to demonstrate microscopically morbid anatomy and to act as curator of the museum[349]. This is the first indication of the instrument being used. It is significant that Nicholas Parker [1821-1888] was a younger man, who had entered the London Hospital in 1839 and had been awarded a London MB degree in 1844. He was elected assistant physician in 1851. He was said to have been an excellent lecturer and an amiable and courteous man.[350] His microscopical demonstrations on morbid anatomy, which he continued until 1854, had begun as a hospital rather than as a school activity but became integrated in the teaching programme in the early 1850s.

William Carpenter obviously worked to establish anatomy and physiology as a separate discipline, and the Medical Council minutes for 28 July 1847 record that a resolution was passed that

> The course of General Anatomy and Physiology should stand in the Prospectus separate from the course of Descriptive and Surgical Anatomy, as arranged at the other medical schools, but that it be distinctly understood that the pupils are required to attend both courses in order to obtain their certificate.[351]

In 1847 Dr Carpenter was elected to the Chair of General Anatomy and Physiology, but he resigned his post in October 1849 when he was appointed Professor of Medical Jurisprudence at University College. In May 1850 he asked to be allowed to withdraw his resignation and was reappointed. Carpenter explained that he had been under the impression that he would be unable to do justice to both posts but that the experience of the winter session had shown that, with some rearrangements, it would be possible. University College had not opposed his plan, but, Carpenter said, if he was forced to make a choice between University College and the London Hospital Medical School he would abandon the former since "there are points connected with their system of management which, as recent occurrences show, are likely to involve the professors in a great deal of trouble."[352] It is not clear to which events Carpenter referred. There is no record of Carpenter's lectures in general anatomy at the London, but his approach and emphasis can be judged from his introductory lecture given in 1848, at which time he was also Examiner in Physiology at The University of London. In this he said that

> There is one department of anatomy which has risen into increased importance within the last few years, and which is now universally recognised as forming an essential part of the medical education - I mean *General* Anatomy, or the *minute structure* and *composition* of the several tissues of which the body is made up. This has most important bearings both on physiology and pathology. For it is now felt that our fundamental ideas of healthy vital action must test on the knowledge of the powers

> and capacities of the minutest parts of the fabric . . . this is the department of anatomy which is in a state of rapid progress, and in which the greatest opportunities present themselves for making additions to the stock of information already attained.[353]

References to the use of the microscope in morbid anatomy by Dr. Parker continued to be made until 1853, when the office of curator of the museum was advertised. The duties included . . . "he shall dissect and examine microscopically if necessary fresh morbid specimens and keep a commonplace book for the registry of the appearances presented . . ."[354] On August 1st 1853 Dr Andrew Clarke was elected curator of the museum[355] and, in June 1854, he was authorised to provide a cabinet for microscopical preparations at a cost not exceeding £10.[356] The Treasurer's accounts for 1854 also show that a Smith and Beck microscope was purchased for £16.11s. Carpenter and Clarke were obviously expected to cooperate since they were jointly requested to order two convenient mahogany stands for microscopes and to consult Mr Luke[357].

That ownership of a microscope was becoming important for medical students at the London Hospital is shown in the fact that in May 1853 a student, H R Debenham, to whom three gold medals had been awarded had requested that the value of the medals be expended in the purchase of a microscope. Dr Parker was asked to arrange for the purchase of an instrument "at a sum not exceeding £15 15s".[358] It was later decided by the Medical Council that if any pupil was awarded more than one gold medal he could have the equivalent in instruments or books.[359]

Paget at St Bartholomew's.

A similar pattern of appointments was followed at St Bartholomew's Hospital Medical School, except that the presence of the Aldersgate School close by and in direct competition with the hospital school highlighted the relative teaching skills and popularity of the lecturers, whereas at the London the students had no choice but to attend the lectures offered there.

At St Bartholemew's Edward Stanley [1793-1862] had succeeded Abernethy and taught anatomy and physiology until the end of the 1841-42 medical session. He had been elected assistant surgeon at the hospital in 1816, at the age of twenty four and acted as demonstrator in anatomy until 1826 when he was appointed lecturer.[360] The Calendar for 1835-6[361] describes his course as being on anatomy, physiology and pathology. Stanley had been elected FRS for his work on pathology in 1830 and his interest in morbid anatomy had led him, with Abernethy's assistance, to enlarge the museum and compile a catalogue of the collection. The plan of his lectures shows that he dealt first with

> The Anatomy of Texture with a General View of the Animal Œconomy, embracing the consideration of the Animal Matter - Fibre - Cellular and Adipose tissue - Fibrous tissue - Membrane - Vessel, its three forms concerned in the Circulation, Artery, Vein, and Absorbent - the Circulation - the Blood -Secretion and Nutrition - Muscular Tissue - Nervous Tissue - Cartilaginous Tissue - Osseous Tissue,

before moving on to descriptive anatomy and the structure and physiology of the organs and the development of the foetus. A "Lecture Book"[362] lists the specimens and drawings Stanley required for his lectures from about 1836 to 1843. Under the heading of 'Liver', museum specimens were listed, together with a diagram on slate of the lobules of liver from Baly's translation of Müller on gland structure.[363] Müller's *Elements of Physiology* had been translated in 1837 by Dr William Baly, who lectured in forensic medicine at St Bartholomew's. The preserved specimens were numbered as they appeared in the Natural Structure series and the Morbid Anatomy series in the museum catalogue. His biographer in *Plarr's Lives* recorded that Stanley held the post of lecturer without distinction, while Thornton[364] stated that although he attained distinction as a surgeon he contributed nothing to physiology. Sir James Paget wrote, with hindsight, that "the physiological portion of the lectures was, even at that time, feeble . . . the physiology of even that time was beyond his grasp . . and the anatomy was very elementary"[365]. Paget recounted how Stanley's lectures were of anatomy, physiology and histology combined and were arranged according to the structures, but that the demonstrations, given by Wormald were taught in the order of the parts dissected. Wormald, Paget said, taught well and was popular with the students.[366]

James Paget [1814-1899] had come to London and entered St

Bartholomew's as a medical student in 1834, having been apprenticed since 1830 to Charles Costerton, a Bart's man and a practitioner in Paget's home town of Great Yarmouth.[367] While apprenticed he had been taught not only the the skills of dispensing and the methods of making up medicines, but had had enough time and enthusiasm to learn the elements of anatomy. He later said that

> the work I was able to do in anatomy, helped as it was by reading, however discursive, gave me I think, nearly as much knowledge of it as most students now have at the end of their first year of hospital study.[368]

He read all the current issues of *The Lancet*, including the accounts of the lectures of Abernethy, Astley Cooper and Lawrence, all the papers in Todd's *Cyclopaedia*, then in course of publication, and taught himself to read French using Bichat's *Anatomie Générale* and a French dictionary.[369] His manuscript translation of the "Introduction to Bichat's General Anatomy", dated September 1832, is today in the archive of the Royal College of Surgeons, and includes Bichat's division of the tissues.

St Bartholomew's was chosen, not only because it was his master's school but also because his elder brother George had friends there. George Paget [1809-1892][370] had been sent to Charterhouse and then gone on to Cambridge where he held a medical fellowship at his college, Caius, but their father's financial situation had not enabled James to follow a similar route. James acknowledged that his brother's university position was of great value since he was not only able to advance him the entrance fee, enough to enter at once for all the lectures and practice then required for the Diploma of the Royal College of Surgeons, but also introduced him into "a good set", offering a social position in the hospital and repute of being a gentleman, though living cheaply.[371] Paget recorded that there was little or no personal guidance for students at St Bartholomew's, that the small library was stowed away in a room next to the operating theatre, and that the dead house was a shed where all stood round the table on which the examinations were made. "Nothing was carefully looked at and nothing was taught", although the museum was in good order and of good repute.[372] Paget said of the lectures that "the mere knowledge of what I learned from them was . . . less than by reading, dissecting room, dead-house and out patients". At home he read the translation of Cloquet's *Anatomy,* "which few ventured on", Mayo's *Physiology,* and, "best of all", Hildebrandt's *Anatomie,* and, as they came out, the parts of Müller's *Physiologie.* These latter two he considered best because with them he learned German, "that priceless power . . . I cannot overestimate the advantage I thus gained, not only in knowledge but in reputation".[373] Only Lawrence and Burrows among his teachers knew German. He was able to give Stanley information for his lectures, and Kiernan asked him to translate Müller's recently published work on the structure of the liver. In his first year he was placed first in the college examinations of the four subjects he entered: Medicine, Surgery, Chemistry and Botany.

In his second year he "worked steadily all through the winter . . helping in the post-mortem examinations when I had a chance. I attended but few lectures of any kind and read a great deal in the long evenings"[374]. A letter from James to his brother George in Cambridge thanked him for the volume of Meckel which he had sent and recorded that "we do no end of minute anatomy and it is daily more and more interesting" - this work took place in the evenings with his friend Johnstone[375]. In that second year he was placed first in the examinations in anatomy and physiology, clinical medicine and in medical jurisprudence. At the end of the session, in May 1836, he was awarded the diploma of the Royal College of Surgeons.

Paget's linguistic skills enabled him to undertake journalistic work to relieve his state of poverty. He was sub-editor of the *Medical Gazette* from 1837 to 1842. There his chief work was to report on lectures and to translate and review French, German and Dutch works. He also wrote annual reports on progress in anatomy and physiology. His first *Report* was published in 1842[376] and reprinted in full in *The British and Foreign Medical Review*[377]. Its design was

> to bring together in the briefest possible space the conclusions regarding the structure and the functions of the several tissues of the human body which have been rendered certain or most probable by microscopic investigation.

Paget thought that

> in no department of medical science has there been so great an addition of facts in the last ten years as in minute anatomy; and in none has the access to knowledge been more difficult. The greater part of the original records of microscopic anatomy are scattered through a multitude of monographs, of brief dissertations, and of essays in the foreign journals, to which few can refer; in our own language there is no work which affords an adequate notion of their contents.[378]

Paget undoubtedly remedied that situation. The first part of his very detailed report related to the structure of the general component parts of the body, and drew material only from original sources. Since Paget considered that

> the fact of the single origin of all the tissues from primary cells suggests that the most natural arrangement of them must be that in which they are placed in a succession corresponding to the degrees in which, in their perfected condition, they severally deviate from the primary form, . . .[379]

he began with the development of cells and the work of Schleiden and Schwann, which had been reviewed in 1840. Paget had sought the advice of William Carpenter on the arrangement of tissues. Carpenter, then lecturer in physiology at the Bristol Medical School, had recommended that tissues be classified in proportion to the degree in which they departed from the character of cells, very much, he said, on Schwann's plan . . . "I should not be disposed to stick very closely, however, to any classification, but rather to give a general view of the elementary tissues."[380] Three further reports, in subsequent years, provided details of researches undertaken during that particular year, and considered these under the various systems and organs concerned, such as the digestive system and the liver.

In 1837 Paget had succeeded Baynton as curator of the museum at St Bartholomew's. Neither this post nor his work for journals earned Paget much money, and he was very poor. The minutes of the Medical Committee of St Bartholomew's Medical College[381] record that in February 1839 the post of demonstrator of pathological anatomy had become vacant and that Dr Black, Dr Baly, Dr Burrows and Mr Paget were applicants for the post. Paget was appointed to what proved to be the beginning of his distinguished teaching career[382].

His demonstrations drew crowded classes,[383] and in November 1839 the students requested that Paget be allowed to give a separate course of lectures on pathological anatomy. This was considered to be inexpedient, but Paget was formally requested to give his demonstrations in the main theatre of the hospital.[384] In 1841 he recorded that he was told that he would become a demonstrator in anatomy, a sure road to the post of assistant surgeon, but this did not come about, as there was opposition from the apprentices, who, as articled pupils to surgeons of the hospital, had by custom first claim to surgical appointments[385]. Paget was in that year, however, elected surgeon to the Finsbury Dispensary. In 1842 he began to write the catalogue to the pathological collection in the museum of the Royal College of Surgeons, a laborious task upon which he worked for many hours each day. He also had, at this time, the opportunity to work with the microscope which had been provided for the hospital museum. Besides this he wrote what promised to be the beginning of a full-sized book on general anatomy, materials for which he found from what he had to read for his annual reports. This work was however refused by Longmans, although for what reason he did not record. He wrote to his brother George . . . "I shall be surprised if I am not disappointed with this Minute Anatomy, which I suspect will only pay, if ever, after a long time, by the reputation it will bring me."[386] It was not a book that was to bring fame to Paget, however, but his work as a teacher and as a surgeon. No reference to the publication of this text can be found, nor have searches of the various archives revealed the manuscript.

Although the separation of anatomy from physiology had already been made in a number of medical schools, including St Bartholomew's rival, Aldersgate Street, the two were not separated at Bart's until 1843. At the meeting of April 15th, 1843 the Medical Committee at St Bartholomew's proposed that anatomy teaching should consist of a course of lectures of descriptions of surgical anatomy and a course of lectures in general anatomy and physiology, and that two teachers of practical anatomy should be appointed annually.[387] It was proposed that Wormald should teach the descriptive anatomy, and Paget the general anatomy and physiology[388]. Paget, in his memoirs, observed that his election to the lectureship was sure, since several of those who had been hospital apprentices were fit to be demonstrators or lecturers on anatomy, but not one could profess himself ready to lecture on physiology; not one had studied it.[389] Paget was far too modest; he had also been able to supply the College with evidence of his skill as a lecturer and of his knowledge of current work in anatomy and physiology. The students who had attended his demonstrations on morbid anatomy had written . . .

> having enjoyed the privilege of attending your gratuitous lectures on morbid anatomy we trust we duly appreciate the benefits and advantages we have derived from your valuable instruction, informed as it has been by perspicacity and eloquence and enriched by the originality of your observations.[390]

William Carpenter wrote of his valuable contributions to medical literature[391], as did George Long the editor of the *Penny Cyclopaedia,* to which Paget was a regular contributor . . . "his articles are clearly written, full of precise information . . . he is well acquainted with what has been done in the French, German and Italian languages for the subjects of anatomy and physiology"[392]. John Forbes, the editor of the *British and Foreign Medical Review,* was even more fulsome . . . " a remarkable power of acquiring information . . . of lucidly arranging . . . a happy facility of communicating his knowledge to others in both writing and speaking . . . master of almost all the continental languages . . . "[393], and from Richard Owen at the Royal College of Surgeons . . . "his lectures . . .have established his aptitude to impart orally the knowledge which he has acquired."[394] Paget was duly appointed. Skey, who had been one of the chief teachers at the Aldersgate School, was offered the anatomy lectureship rather than Wormald, much to the dismay of the students[395]. George Humphry wrote from Cambridge to congratulate Paget . . .

> it most unquestionably and palpably is solely by your own merit - the appointment of Skey in preference to Wormald on the ground of seniority is very plain evidence that you are selected for the overwhelming reason that they cannot do without you.[396]

The appointment was the turning point in Paget's life, not only professionally but financially. He recorded[397] that after his appointment his payment for the lectureship began at £376 per annum and then ranged from £420 to £827, during the years 1843 to 1859. His income from the Royal College of Surgeons, to which he was Professor of Anatomy from 1846 to 1850, was £20 per annum. He continued to write for the *British and Foreign Medical Review* until 1851, although this did not pay well - he had earned £20 for his first *Report* and £10 for the three which followed it. His work for the *Medical Gazette*, though, he gave up. He said later that "the work was at the time very useful to me - I earned some money when I greatly needed it, being paid at the rate of seven guineas a sheet for leading articles, six for reports and five for translations and analyses. I earned about £250 in the four years and I learned to write fluently and to translate as accurately as I could and to listen to discussions and report them without taking notes - for my connection with the journal was not known.[398] With these skills and knowledge at his fingertips it is not surprising that Paget set about his lecturing with the same degree of enthusiasm and attention to detail as he had applied to his earlier work, and his position in the medical college was further strengthened when later, in 1843, he became its first Warden[399].

The content, quality and style of Paget's lectures in anatomy and physiology can be fully assessed by comparing a number of sources: the Medical College Calendars outlined the syllabus to which he taught while his own memoirs gave details of his preparation and style; his own lecture notes are fortunately still in existence and the outcome of his labours can be judged by Kirkes' *Handbook of Physiology*, which was written from Paget's lecture notes.

The course was entitled 'General and Morbid Anatomy and Physiology'.[400] It began with the structure of the blood and then dealt with the principal elementary and component tissues: cellular, adipose, elastic, fibrous and muscular. The anatomy of organs, such as the liver, was discussed under the heading of the system of which they formed part, the digestive and the secretory. The morbid anatomy of organs was considered in connection with their natural structure, but took the form of demonstrations of the changes of structure, illustrated by post-mortem specimens and those in the anatomical museum. Paget recorded that he lectured every day for six months, five days on general anatomy and physiology, and, on the sixth day, morbid anatomy. His lectures, he said contained

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Figure 5.
Royal College of Surgeons Archive
Paget papers, enclosed with notes of
lectures, 1843-44.

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extremely little original matter; scarcely, even, any original thought . . . I read everything . . . I tested much of what was written, and worked with the microscope and repeated the less difficult experiments . . . thus I kept on a level with all but the best knowledge of the day, and in advance of the teaching of physiology in most of the Schools in London. My lectures supplied nearly all the materials for the first edition of Kirkes' Physiology. He was one of my best pupils . . . the early editions of this manual may show what the lectures were in material and extent; but I cannot doubt that they were chiefly attractive by reason of the seeming facility and the fluency with which they were given. I always had the power of what is called 'extempore speaking'. I never spoke on any considerable occasion without careful preparation . . . on occasions of less importance I used to learn by heart the chief parts of each lecture or address, and to form for other parts a general intention of what should be said, and trust for the words to the thought or impulse of the time"[401].

His actual notes[402] bear out this statement. They were written in full and included reminders to himself. It is possible to follow not only his delivery, but also the point at which he used his teaching aids. Small drawings were included in the notes, presumably those which he proposed to make in the course of his lecture. For his first three lectures in 1843, when he discussed the development of tissues, he listed his illustrative material on the back of an envelope[403]. [See fig. 5]. This included microscopic 'views' and preparations, drawings already on a slate, and various diagrams. Paget revised his notes for his second and subsequent series of lectures with additional material written over the original notes at right angles. His many new references show that he kept up with current work in anatomy and physiology and incorporated it into his lecture notes. He did not necessarily include all his material in the lectures themselves. He noted that

each should include as much as possible of what is general and elementary on the subject, but it will be best not to attempt to be complete or exhaustive . . . what is omitted in the systematic lectures may generally be included in the clinical . . . [404].

The notes of his first lecture on the anatomy of the liver, lecture 60, show that it was delivered on December 13th 1843. The notes included "the lobules - what they are - as seen on the surface - form of long. and trans. section" together with an indication that fresh liver was torn to show the structure. His notes ended with an appraisal of current understanding of the secreting structure, including comments obviously intended to guide him during his lecture . . . "no cellular tissue therein - Mr Kiernan's only mistake . . . do these cells contain bile . . . various hypotheses of Henle as to how they communicate with the ducts - but nothing definite can be said . . ."[405] He referred at the end of the lecture to Erasmus Wilson's paper on liver in Todd's *Cyclopaedia* and to Carpenter's texts, but added "not Budd." His notes were followed by an 'order of recapitulation' for that lecture.

Two sets of detailed notes exist on the physiology of the liver, one set was revised yearly over the period 1848 to 1853 and the other written in 1854 and revised until 1859 when he resigned his post. A note inserted in the first set said that "much of this lecture is in confusion, but not more so than is likely to remain while the chemistry of the bile is unsettled. It must be <u>well got up</u> and given in <u>strong</u> outlines, omitting minute analysis." A note inserted in the second set commented that "the spaces must be filled up according to references or otherwise from: the notes of old lecture; Bidder and Schmidt, Constatt; and anything new that may appear." These at first appear to be notes intended for some other person, but the fact that such notes appear in succeeding years and that, in 1857, they said "same, but <u>absolutely</u> needs revision or at least some clearing" suggests that they were his own memoranda.[406]

Paget also kept small pocket books[407] into which he noted new references. The book he used between 1852 and 1854 included, under the heading 'General Works', texts by Quekett, Kölliker, Todd and Bowman and references to papers in Müller's *Archiv.* Also listed is "MS on General Anatomy". It seems possible that this was his own manuscript which he had kept for its detail. Under 'Liver' he listed works by Virchow, Moleschott, Bidder and Schmidt, Nardi in Constatt, and Weber in Müller's Archive. At the back of the same notebook he listed topics he needed to work on or books he felt he should read, such as, Weal's *Histologie,* Virchow's *Pathologie,* and Robin's *Sur l'anatomie de tissus erectiles.* In another pocket book he listed again his general anatomy manuscript, with a note "read and destroy". This could account for there being no trace of the manuscript today, which otherwise is hard to explain in view of the way in which he kept other notes from year to year. It may also have some bearing on the fact that Kirkes' text is on physiology alone and does not include a separate section on general anatomy.

William Senhouse Kirkes [1823-1864] had been a student of Paget, and in 1845 was appointed medical registrar and demonstrator in morbid anatomy at St Bartholomew's, having graduated MD at Berlin in 1846[408]. It was in 1848 that Kirkes, in conjunction with Paget, published his *Handbook of Physiology*[409]. This was based on Paget's lectures. A set of manuscript notes taken direct from Paget's own lectures by Frederick Hoare Colt, a medical student at St Bartholomew's in 1845, was used by Kirkes as the basis for his first draft of the book. The manuscript is still extant although perhaps little known.[410] On comparing Colt's notes for lecture sixty, on the anatomy of the liver, with Paget's own notes, it is possible to see just how smoothly and skilfully Paget delivered a coherent account of the gross and minute anatomy and the physiology of the liver. Colt did not include sketches in his notes, nor did he refer to any use of microscopical preparations to demonstrate structure. In Kirkes' book, however, there is a figure showing hepatic or bile cells, and such cells filled with fat particles.[411] Kirkes also states that "on the structure of the liver the student should read the original paper of Kiernan, or the description by Erasmus Wilson in the Cyclopaedia of Anatomy, and in Dr Budd's Treatise on Diseases of the Liver."[412] Kirkes, in his preface to the first edition, pointed out that

> the publishers of Dr Baly's edition of 'Müller's Elements of Physiology' had long designed to render it more available for the general use of students . . . the present work was commenced with the intention of fulfilling their design . . . it was found that the progress of Physiology during seven years had so increased or modified the facts and even some of the principles of the science that 'Müller's Elements' and the notes added by Dr Baly, could only be employed as among the best authorities and examples.

He added that the book was arranged on a plan corresponding with that in which they were taught in the courses of lectures on physiology delivered in the principal metropolitan schools of medicine.[413] In his second chapter, headed 'Structural composition of the Human Body' he described the structure and development of cells, quoting Kölliker and Henle, and described the primary or elementary cells, intercellular substance, fibres and tubules. Most of the tissues, he said, which were composed of the primary structures would be briefly described in the subsequent chapters, and in connection with the physiology of the organs they helped to form. The insertion of a system of general anatomy, he went on, would not further the purpose of the work while the student had access to

> **such admirable works devoted to the subject as the Introduction to Quain's Anatomy by Dr Sharpey, the Physiological Anatomy of Dr Todd and Mr Bowman, the Microscopical Anatomy of the Human Body by Mr Hassall, and the various articles on tissues published in The Cyclopaedia of Anatomy and Physiology.[414]**

Paget kept an entry book of notes on his students and what became of them[415]. On F H Colt Paget observed that he was an exceedingly intelligent, acute man, precocious of his work and knowledge. On William Savory he made no comment, but underlined the name twice. Savory was, in 1849, appointed as demonstrator on anatomy, having recently gained three gold medals and graduated MD of London University.

In April 1851 Paget was elected FRS. In July of that year he gave a lecture at the Royal College of Surgeons entitled 'The recent progress of Anatomy, and its influence on Surgery'. Paget used the word anatomy in its widest sense, to include general and morbid anatomy. He spoke of recent observations using the microscope which bore on surgical practice and urged the use of the instrument in pathology . . . "the microscope must be used, with all other methods of research . . ."[416]. His lectures on surgical pathology at the College of Surgeons were published in 1853 and these too had the use of the microscope as a foundation. His obiturist in *The Lancet* said that at a time when the general introduction of the use of the microscope into the examination of morbid tissues and products was leading to an over-estimation of the value of structural details, Paget saw clearly that the mode of life of a tissue was as essential a part of its being as was the arrangement of its constituent fibres and cells[417]. Paget's own account was that he designed lectures which might illustrate the general pathology of the principal surgical diseases, in conformity with the larger and more exact doctrines of physiology.[418]

The Value of the Study of Minute Anatomy.

The necessity for a good understanding of normal minute anatomy as a prerequisite to an understanding of pathology was well illustrated by George Budd, in his *Diseases of the Liver,* which Kirkes recommended to his readers.[419] Budd was professor of Medicine at King's College and acknowledged Bowman's help in supplying microscopical specimens illustrating the structure of the liver. In his second edition he thanked Lionel Beale for assisting with chemical analyses. He introduced his text with as account of the normal structure of the liver, beginning with its microscopical appearance, using both injected and fresh specimens for illustration. He credited Kiernan and Bowman in England, and Müller and Henle in Germany with describing what he called the 'intimate structure of the organ' . The chapter was illustrated by Bowman's woodcuts and Kiernan's diagrams. The more recent work of Handfield Jones was also referred to[420]. A review[421] of the text however, while noting his interpretation of these workers, regretted that, in his second edition, Budd had given no account of the results of continental anatomists such as Retzius and Guillot.

Budd had spoken of the great importance of minute anatomy in the understanding of disease in his introductory lecture at King's College in 1847:

> . . . by the use of the microscope our powers of vision are immeasurably strengthened and the eye penetrates to the very rudiments of organisation . . it is in the ultimate elements of structure that the most serious diseases originate . . . it is in the minute structure of the body that these incessant changes - these never ceasing processes of waste and repair - take place, and it is through some fault in these processes that the most serious diseases are engendered . . . unless we know what the intimitate structure of an organ is . . . it is hopeless, in many cases, to attempt to discriminate and to trace to their respective sources, the various changes that disease produces in it[422].

Not everyone shared Budd's enthusiasm, however. In the previous year E W Murphy, Professor of Midwifery at University College, had struck a note of caution . . .

> we can perceive in the study of the microscope the elements of a revolution in our notions of disease which may ultimately produce an important change in the study of medicine, but in the present state of our microscopic education too much caution cannot be exercised in founding any conclusions on the molecules revealed by this valuable instrument.[423]

Also at University College, Walsh, a physician, had been even more cautious, particularly with regard to therapeutics, and had declared the microscope "an instrument of tyranny". He had depreciated, he said, the proneness to accept, without scrutiny and without question, statements on points of microscopical observation, no matter how untried or how unknown the person who advanced them. The evil, he added, did not rest there . . . "they modify the treatment of some of other disease in harmony with the new principle"[424] .

In contrast, Caesar Hawkins, in his Hunterian Oration of 1849, considered that

> the increased and increasing importance paid to general anatomy has, perhaps, mainly contributed to our scientific knowledge . . . it has already caused a change in our ideas of life, and of the mode in which living bodies perform their various functions . . .[425]

In that same year the *Medical Times*, in an editorial headed 'Physiology and Medicine' declared that

> so deeply do we feel the importance of microscopic anatomy to practical medicine, that we have made special arrangements to bring to the notice of our readers the fullest information on the subject.[426]

In *The Lancet* of 1850, the reports of the introductory lectures which marked the beginning of that year's medical session showed that the value of microscopic anatomy to a range of disciplines was widely acknowledged. Some teachers, such as Edwin Lankester at the school adjoining St George's, were very precise . . . "The sole hope of the pathologist for the future is the use of the microscope - without it the science would stand still"[427], while others, such as Dr Aldis at the Hunterian School saw little in general anatomy beyond "the revelation of the wisdom and design of the creator."[428] In the following year Dr Basham at the Westminster Hospital said that microscopic anatomy or histology had already interpreted much which was formerly veiled in obscurity, and that the microscope had become as necessary to the anatomist and pathologist as his scalpel.[429] Dr Parker, at the London Hospital felt that the invention and proper application of the microscope had done almost as much for some branches of medical knowledge as the invention of printing had done for the extension of knowledge in general. Histology, he said, was a new science; morbid anatomy had been reconstructed and physiology remodelled[430].

It is clear that by 1850 the majority of schools saw the virtue of a separate course on general anatomy and physiology, and also that a range of teachers in related disciplines appreciated the necessity for all students of an understanding of histology, as it was increasingly becoming known. It should not be thought however that the medical schools made changes to their teaching programmes simply because the importance of histology was becoming more widely recognised. Other disciplines too jostled for space and time in the curriculum. A main stimulus for change remained the requirements of the licensing bodies and of the University of London. The University had been constituted in 1836 as an examining body, with powers to grant degrees to students from University College and King's College and to any other college in the United Kingdom approved by the Privy Council. All the principal London schools were recognised by the Senate and the Privy Council, but this had little effect on the curriculum they offered, and the majority continued as isolated teaching institutions, dominated by the clinical staff.

The Effect of Regulation.

One of the first acts of the Senate of the University had been to set up a committee to draw up regulations for degrees, the first examinations being in 1839. There were two examinations, after two and after four years study in a recognised institution. The emphasis in the first examination was on basic subjects, whereas the second was on clinical aspects. The first examination for the degree of BM had as a requirement having attended four courses of lectures from a list which included general anatomy and physiology, together with descriptive and surgical anatomy, pathological anatomy and comparative anatomy. The regulations also stated that previous to the year 1841 attendance at a separate course on general anatomy and physiology would not be insisted upon. The recommendation was that physiology and general anatomy should be taught in the winter session of the second year[431]. In the same issue of *The Lancet* as that in which the University regulations were published, the regulations for the Apothecaries' Hall included the need to have attended a course in anatomy and physiology in the first two winter sessions[432]. Similarly the Royal College of Surgeons required the attendance at one hundred and forty lectures on anatomy and physiology during the first two winter sessions[433]. It would be necessary, therefore, for colleges which had not already divided their anatomy and physiology to create a course on general anatomy and physiology, as distinct from that on descriptive and surgical anatomy, either to supplement the teaching for those who wished to enter for the MB examinations, as happened at St Thomas's, or else deny the students the opportunity to do so.

One might have expected that the London MB would have played an important role in the London schools, but this seems not to have been the case. Le Quesne has reported that for about forty years after its inception, only about twenty students each year obtained the degree, the majority qualifying by means of other diplomas.[434] There were several reasons for the failure of the MB to make a real impact on the schools: the level of secondary education of many of the students was so poor that many failed the matriculation examination; similarly the failure rate in the preliminary sciences examination in its first twenty five years was nearly 50%. The whole series of the MB examinations was considered to be both more difficult and more academic than the alternative roads to qualification.[435]

It is interesting to note that at the beginning of the Medical Session 1850-1851, at the time when James Paget was Professor of Anatomy and Physiology at the Royal College of Surgeons, Lawrence, Stanley, Skey, Wormald, Luke and Kiernan, amongst others, were on its Council, while at the University of London Kiernan and Sharpey were the examiners in Anatomy and Physiology. The old school was well represented!

Under the general heading of 'Medical Education and Medical Reform', the editors of *The British and Foreign Medical Review* remarked that it was in the regulations of the University that they recognised for the first time all the essential elements of a complete medical education. They hoped that

> whatever improvements may be the result of the agitation now on foot in Great Britain and Ireland, they will be imperfect unless they contain provisions for enforcing an education, preliminary and professional, as liberal, at least, if not precisely the same.[437]

Progress in Continental Europe.

In continental Europe, meanwhile, advances were being made, with the aid of the microscope, in both physiology and pathology. A general account of this, in the context of developments in histology has been given by Bracegirdle[438]. The focus of the work in France was in Paris, and Ackerknecht has given an account of microscopy in what he called the 'Paris Hospital'[439], while Foster examined medical microscopy in the furtherance of pathology[440]. More recently La Berge has given a detailed account of the teaching of microscopy in Paris from 1830 to 1855[441]. Each of these authors has emphasised the importance of the work of Alfred Donné, and his influence on his student John Hughes Bennett [1812-1875].[442]

On Bennett's return to Edinburgh he established, in 1841, the first practical classes in medical microscopy to be held in Britain. The introductory lecture was published in the form a small booklet[443]. In a review of the pamphlet in the *Microscopical Journal* the editors remarked that it would be a matter of surprise to them if the London Medical Schools did not appoint professors for the same purpose and that it was surprising that the Senate of the University of London, "many of whom have gained their laurels by the use of the instrument, have not made it requisite for students . . . to attend at least *one* course, even were it to consist of *twelve* lectures on the Microscope."[444]

Bennett's introductory lecture given in 1845, gained a much larger audience, since it was published in *The Lancet*. Bennett ended on a note of caution . . .

> I am anxious to impress upon you, that we should regard the microscope only as a means to an end . . . aim at increasing your powers of observation, and of reasoning correctly on the facts presented to you, than waste time in improving optical and mechanical parts of an instrument, which, however useful, is, after all of secondary importance.[445]

General Anatomy Textbooks.

The *British and Foreign Medical Review*, as was their custom, reviewed Bennett's 1842 booklet with a group of other texts on general anatomy, those of Henle, Gerber, Gerber and Gulliver, Bruns, Köstlin, Mandl, and Klencke, of which only that of Bennett and of Gerber and Gulliver were in English.[446] Henle's text was considered such as no other man in Europe could have written, and Mandl's treatise the best which has been produced in France upon microscopic anatomy. Bennett's booklet, it said was

> unconditional, and therefore an unwise, panegyric on the microscope. All that is stated on microscopic evidence is advanced as if it were certain truth; yet in the lapse of a year doubt has been cast on a great moiety of the *facts* which it contains.[447]

In their 'history and mode of study of minute anatomy' which followed the review, the editors, with great foresight commented that

> at the very best, the microscope teaches only the coarse outlines of the forms of the apparatus in which the processes of the living body are carried on; . . . These processes depend, without doubt, upon the mutual relations of the elementary particles, the atoms of the body; and the distance at which they are still removed from our view, infinitely small.[448]

Hughes Bennett's view that every practitioner should be able to use a microscope, together with the recognition that the majority would be unable to do so if they were given the opportunity, was echoed in *The Lancet.* In its editorial for the issue of June 24th, 1843, under the heading 'Neglect of the Study of Anatomy' it stated that

> if a microscope were placed in the hands of a large proportion of persons whose business it is to study medicine, they would not even know how to use the instrument, much less to guard against the numerous fallacies which attend microscopic observations with those who are inexperienced in such researches.[449]

The journal's review of the recently introduced *Microscopical Journal* bemoaned the state of affairs in Britain compared with that in Europe . . .

> On the continent the spreading taste of scientific men for minute and microscopic investigations . . . has, in recent times, laid open departments of research altogether new to science . . . it does not redound to the credit of English physiologists to remark that this country occupies a disparaging position in the more abstruse branches of science, to which the recent improvements in the construction of the microscope have introduced us.[450]

Only one man sought to remedy the situation in Britain at that time, by producing an illustrated text devoted to microscopical anatomy. Hassall's *Microscopical Anatomy of the Human Body* was begun in 1846 and published in parts until its completion in 1849[451]. A review of it, in a German journal, summed up the author's intention. Having named a large group of British workers, including Kiernan, Sharpey, Goodsir, Todd, Bowman, Quekett,

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Figure 6.
A H Hassall - *The microscopic anatomy of the human body, in health and disease.*
London: Churchill, volume II, 1849.
Plate LV.

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Carpenter and Handfield Jones, it said that

> the results of their labours are to be found in the form of articles or essays in the various periodicals of the day, or dispersed in elementary text-books, and there existed no work in which these were collected so as to be preserved to science, or be made available to those who might use them, not as professional microscopists but as practical physicians.[452]

The result of Hassall's industry was a two volume work, the first of which was text and the second several hundred coloured drawings and their captions. In the section on liver, Hassall quoted the researches of Kiernan, Bowman, and Handfield Jones, indeed the latter's recent paper in *Philosophical Transactions*[453] was quoted at length. Hassall's plates were not particularly informative, being of injected preparations which, although colourful, and reflecting the skill of the maker, did little to inform on structural detail. Plate LV, fig. 4, for example, showed "a section of liver in which the interlobular portal vessels are shown. The injection in this case fills only the principal vessels, and has not extended to the capillaries."[454] [See fig. 6]. Specimens had been lent, for this section, by Quekett and Handfield Jones.

Dr. Arthur Hill Hassall [1817-1894] was not a microscopical anatomist by training, but rather, an amateur botanist and natural historian. The spirit in which his work was undertaken is illustrated by his own account . . .

> I determined to apply the microscope to some subject of more professional interest and of wider and more general importance. I therefore commenced the examination of some of the tissues of the human body and being charmed and fascinated by what I saw, resolved to microscopically examine systematically all the fluids, tissues and organs of the body . . .[455]

He attended post-mortems at St George's hospital and engaged a microscopical draughtsman, Mr Miller, who made drawings from the preparations and drew them on stone[456]. It is easy to see that this process could bear little comparison with the faithful rendering of some workers such as Donné, who both understood what they were seeing and used objective methods of illustration. Nevertheless, *The Lancet*, which reviewed each part as it appeared, gave it cautious praise . . .

> the attraction of Mr Hassall's work to the practitioners of Britain will be its delineation and description of the human textures, and the more he adheres to these objects, the more eminent will be the success of his great undertaking[457].

There was undoubtedly some dissatisfaction with the plates, as correspondence between the author and readers of the journal illustrated. One letter from Miller, the draughtsman, said that "the subjects figured under the microscope were all made with the greatest attention to accuracy; it is, therefore to the error in printing alone that the coarseness of the rejected plates is to be attributed."[458] The *British and Foreign Medico-Chirurgical Review* devoted eighteen pages to a review of the volumes and was more direct in its criticism. The major fault was, it said Hassall's very imperfect acquaintance with the general state of opinion amongst microscopists on many important topics, and a too great confidence in his own judgement when opposed to that of men of more experience as observers and of higher qualifications as interpreters of what they observe.[459]

No such faults, however, could be found in the work of the Swiss histologist Rudolf Albert von Kölliker [1817-1905], who was professor of anatomy and physiology in Wurzburg. His *Manual of Human Histology* was published in the German language in 1852. The work was edited and translated into English by Busk and Huxley in the following year.[460] One of Kölliker's major contributions was the placing of histology on a cellular basis. Maulitz[461] has said that, with Henle, Kölliker was a key figure in injecting the cell theory of Schwann into the medical world and particularly into the teaching of anatomy. Outside of Germany, he said, the manual of histology of Kölliker was unrivalled in its impact with respect to disseminating the cell theory in medical circles.

In his preface Kölliker had said that "Medicine has reached a point, at which Microscopical Anatomy appears to constitute its foundation . . "[462]. In his excellent introduction he explained the point of view from which histology could be considered a science and the relations of this science to the cell theory of Schwann. He ranked Bichat's *Anatomie Générale* as the first attempt to study histology scientifically. If Bichat, he said, had founded histology more theoretically by constructing a system and carrying it out logically, Schwann had, by his investigations, afforded a basis of fact, and had thus won the second laurels in the field. Kölliker, with great foresight, also added that if, in the future, the molecules which constituted the cell membranes, muscular fibrils etc, should be discovered . . . then a new era would commence for histology and the discoverer of a *molecular theory* would be more celebrated than the originator of the doctrine of the composition of all animals out of cells.[463]

Kölliker's excellent work was the first textbook of histology by modern standards. It began with the nature of the cell, and went on to describe tissues, organs and systems. The work of Kiernan still formed the basis for his section on liver, which was illustrated with woodcuts.[464] The reviews were particularly laudatory . . .

> it is a most celebrated treatise on the textures of the human body, - their structure, chemical composition, vital properties, and mode of development, - in which micrography performs its fitting part, but is ever kept in its due subordination; and no name has been more honourably associated with the progress of physiological anatomy for the last decennium, than that of Professor Kölliker,[465]

and . . . "no histological manual has appeared in any country at all comparable with it for exact research in matters of detail, for completeness as a whole, for breadth of view . . . "[466]. Significantly, T H Huxley's review of works concerned with the cell theory included not only the works of Schleiden and of Schwann, but also Kölliker's manual.[467]

The *Medical Times,* true to its word, continued to bring matters microscopical to the notice of its readers. In 1851 a series of lectures by John Quekett was published in its pages.[468] John Thomas Quekett [1815-1861] was the assistant conservator of the Hunterian Museum at the Royal College of Surgeons, having begun his work there as student of human and comparative anatomy in 1840.[469] He kept a diary of his daily activities, which is now in the archive of the College, and which provides a very personal view of his duties.[470] One of his responsibilities was to deliver a course of lectures at the College, and in 1851 these were published as a series, and later, after some revision, as a text.[471] Unlike the work of Kölliker, that of Quekett was concerned not only with human histology but also with that of plants and of some invertebrates. His animal histology was limited to that of tissues and he gave no account of the microscopical structure of organs. He adopted the classification of Todd and Bowman, in their *Physiological Anatomy*, for his lectures. The series printed in the *Medical Times* was illustrated by numerous well executed woodcuts.

It is clear from his diaries that he made many diagrams for use in his lectures[472], and that he had an assistant, Aldous, who made sketches for him using a camera lucida. There is also reference to his use of a "railway" [see page 282 below] to carry a microscope from one end of a bench to the other so that the specimens could be passed round during the demonstration . . .

> 15th Feb. Occupied in preparing diagrams for tomorrow's lecture and in superintending the re-putting up of the railway in the theatre. Mr Lister comes soon after eleven and I show him all the apparatus and some of the more interesting of the microscopic preparations.[473]

The diaries reveal that the whole basis of his lectures was the large number of specimens he demonstrated. The specimens he prepared himself from materials he acquired from hospitals, dead houses, the zoological gardens and the various London markets. Quekett's position at the Royal College of Surgeons, at a time when Richard Owen was the conservator, meant that he was well known in professional circles. He mentioned visits to 'microscope parties' where he met such eminent men as Todd, Bowman, Solly, and Lister.[474]

That more men were becoming interested in the use of the microscope is clear from the increasing amount of correspondence on the subject in the medical press. In *The Lancet*, under the heading 'Questions about the microscope', a 'country surgeon' had written to enquire where he could get "a good working microscope at reasonable terms". He had gone on to ask "supposing the instrument be obtained, how are we to learn its use . . . Quekett's work is large and expensive".[475] Quekett had published a practical treatise on the use of the microscope in 1848, which went to a second edition in 1852.[476] This was the first book from which a medical practitioner or student could learn for himself how to use a microscope and to prepare specimens. In his preface, Quekett said that the different modes described of preparing and examining specimens were the result of his own experience. The book was very well received by the medical press. The *British and Foreign*

Medico-Chirurgical Review said it knew of no subject on which a good book was more needed than on the use of the microscope.[477] *The Lancet* was unable, it said, to explain the limited use still made of the microscope, when all who devoted themselves to the study of healthy and diseased tissues knew that it was an essential instrument without which structure would be "nothing more than a mass void and formless". It concluded that the only explanation was the difficulty in using the instrument and that "a little habit, with Mr Quekett as a guide", would soon remedy the difficulty. The reviewer did, though, urge men not to interpret what they saw according to their own notions - "the observation may always be correct - the inferences may be often wrong."[478]

John Goodsir, then Professor of Anatomy in the University of Edinburgh, edited in 1853 Hannover's *On the Construction and Use of the Microscope*. This treatise was in use on the Continent, but, unlike Quekett's text, was concerned almost entirely with the instrument itself, rather than with the preparations which could be examined with it.[479]

In 1853 the *Medical Times and Gazette* printed a series of lectures which went some way towards satisfying the country surgeon's need. This was entitled "Histological Anatomy and Microscopical Manipulation" by Dr Boon Hayes. Boon Hayes was described at the time as "formerly Lecturer on Anatomy, Physiology and Pathology at the Sydenham College, Birmingham". It would seem that the series of lectures was adapted from the one he delivered at Sydenham College. He divided his course, he said, into four sections: the mechanical and optical construction of the microscope and its manipulation; physiological histology, or the application of the microscope to the examination of the healthy tissues of the human body; pathological histology, or the application of the microscope to diseased tissues and products, and as an instrument of diagnosis; and the application of the microscope to therapeutics and medico-legal inquiries.[481] The lectures appeared once each fortnight, but unfortunately the series was unfinished and did not go beyond the second section, nor was it printed as a text.

In his first lecture, Boon Hayes said, with great foresight, that

it is more than probable that lectures *upon histology* will be given at all schools of

> medicine. Already do the examining boards (if we judge from their test questions) demand a considerable knowledge from the student on the subject; and already has its importance in its most extended applications been fully recognised by one of our most influential examining boards, as seen in the appointment of Mr Quekett to a Professorship of Histology in The Royal College of Surgeons of England.[482]

He went on to name Sharpey, Goodsir, Bennett, Bowman, Redfern, Quekett, Johnson, Paget, Golding Bird, and Wharton Jones as men who had made special discoveries of a physiological and pathological nature. Boon Hayes added that it was his firm belief that one of the next steps of advance in medical knowledge would be made when the microscope and organic chemistry went hand in hand in the investigation of disease.[483] His first two lectures generated a large number of letters to the editor of the journal[484]. The second part of the series, on the "physiological demonstration of the tissues" began with the cell theory, quoted the work of Schwann and Schleiden, but referred his readers to Quain and Sharpey for a full account[485]. He gave his readers precise details on preparing specimens for observation, and did so in a simple and systematic way, such that the course could be followed by a student or practitioner working alone.

It is interesting to follow the way in which Boon Hayes is styled as the series of lectures progressed. From being formerly at Sydenham College, he became Lecturer upon Pathological and Morbid Anatomy at the Hunterian School, and later, in addition, Physician to the Northern Dispensary. Prior to the publication of the series, the only mention of its author had been in the November 1851 issue of *The Lancet*, when a report of his inaugural address delivered at the opening of Sydenham College, Birmingham, was reported.[486] The report said of it that "Mr Hayes address seems to augur a brilliant and useful career for Sydenham College, and if the other lecturers possess talents as undoubted and as practical, Birmingham will be better off for medical schools than any other provincial town in the kingdom." Why Boon Hayes left Birmingham so quickly is not known, but his arrival in London is significant in the history of the teaching of histology in the metropolis.

It is clear that by the 1853-1854 medical session, the level of understanding and of interest and enthusiasm in histology was rising in the medical schools in London. It remained for Boon Hayes and others to translate the interest and understanding of a few into practical investigation for all.

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429. Dr Basham (1851) - Introductory lecture at the Westminster Hospital School, *The Lancet*, **2**, 333.
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463. Ibid., vol. 1, p. 3.
464. Ibid., vol. 2, pp. 111-136.
465. *The British and Foreign Medico-Chirurgical Review*, **9**, 208 (1852). Review of Kölliker's *Mikroskopische Anatomie.*
466. *Q.J.M.S.*, 1851, 133. Review of Kölliker's book.
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468. *Medical Times*, **23**, (1851): 1-2, 58-60, 112-115, 170-173, 225-228, 309-311, 366-368, 446-448, 501-503, 555-557, 607-609, 661-663, **24**, (1851): 6-8, 85-87, 140-141, 379-380, 451-453.
469. For details of Quekett's life see B Bracegirdle (1988) - Famous microscopists: John Thomas Quekett, 1815-1861, *Proceedings Royal Microscopical Society*, **23**, 149-169.

470. The Archives of the Royal College of Surgeons contain a series of diaries written in Quekett's own hand:- 42.c.49, 17 August 1840 - 17 May 1841; 42.c.50, 18 May 1841 - 12 July 1842; new acq., 13 July 1842 - 5 Sep 1843; 42.c.51, diary for 1844; 42.c.52, diary for 1845; 42.c.53, diary for 1847; 42.c.54, diary for 1848.

471. J Quekett - *Lectures on histology delivered at the Royal College of Surgeons of England.* London: Bailliere, 2 vols, 1852 and 1854.

472. Quekett diary, op.cit. note 470 above. Entry for 4 January 1848.

473. Ibid., 15 February 1848..

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475. *The Lancet,* 2, (1852), 70.

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481. J Boon Hayes (1853) - Histological anatomy and microscopical manipulation, *Medical Times and Gazette,* **27**, 27-30, 83-85, 155-158, 263-266, 313-316, 391-392, 441-443, 547-548, 593-594, 645-646, **28**, 132-133.

482. Ibid., **27**, 28.

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484. *Medical Times and Gazette,* **27**, (1853), 154.

485. Boon Hayes, op.cit. note 481 above. See **27**, 263.

486. *The Lancet,* issue of 29 November 1851.

CHAPTER THREE.
HISTOLOGY A REQUIREMENT: 1854 - 1870.

It has been demonstrated in the previous chapter that by 1854 it was accepted that a knowledge of normal and pathological histology was essential for the medical student. Histology was not, however, required to be taught as a separate course by the licensing bodies, and The University of London, while including general anatomy amongst its options, did not make it a compulsory subject for all candidates for the M B degree.

First hand experience of the use of the microscope for the examination of tissues was very limited. Demonstrations were offered in the curriculum of the majority of the medical schools, but only rarely would a London student have easy access to a microscope. The enthusiastic student may have been able to use a college microscope to support and confirm, with the aid of texts such as Quain and Kölliker, observations and demonstrations made in the class. The opportunity to use the instrument to examine fresh or permanent preparations, as a part of a course, such as that offered by Beale at King's, was available only rarely, and then only catered for the very few men who had the inclination and the funds to attend. No college had facilities or equipment, and few had expertise, to teach a regular course in the use of the microscope and its application to histology. In any case, while such a course was not compulsory, it would have been difficult to justify its inclusion in a medical curriculum which was rapidly expanding to include other clinical specialisms such as ophthalmology and dermatology, practical subjects such as surgery, which had recently been made a course requirement by the Royal College of Surgeons, and chemistry, in particular physiological chemistry, and physiology itself, all of which competed for time and space.[1]

One factor, however, which influenced the establishment of histology, particularly practical histology and the use of the microscope, was the competition between the colleges, each anxious to demonstrate its ability to offer courses in the newest technology.

This chapter explores the developments in both the medical schools and the licensing and examining bodies, and in legislation, which culminated in the study of histology, including practical histology, becoming a requirement for membership of the Royal College of Surgeons in 1870.

University College

At University College, Sharpey continued his teaching of general anatomy and physiology. Taylor contends that we have no evidence about the substance of his teaching in the 1850s and 1860s until the Thane manuscript dated 1867[2]. Research for this thesis has revealed two additional sets of notes for this period, those of Whishaw taken in 1855[3], and those of Cotterell Tupp in 1860[4]. There is no evidence that either Whishaw or Tupp went on to make any mark on the medical profession, but their notes, together with the Thane manuscript[5] and earlier notes referred to above[6], provide a continuum of information on the content and style of Sharpey's lectures over his long tenure of the professorship.

The notes of J C Whishaw were written at the beginning of the 1855-56 Winter Session, and the style suggests that they were taken down verbatim. The form and order of the notes indicates that Sharpey, not surprisingly, used for his lectures on histology the same arrangement as that in his latest edition of Quain's *Anatomy*[7]. Whishaw, who referred to his professor as 'Dr Sharpeyebus', included notes of Sharpey's personal view on some aspects of his subject. In the section on the transformation of cells into fibres, for example, Whishaw noted that "Dr Schwann believed that a cell might be elongated and split up into fibres. Dr S is cautious in inculcating this"[8]. Small labelled diagrams were included in the notes, clearly copied from diagrams referred to and displayed in the lecture room. There is no indication that any opportunity was given to the student to observe microscopical preparations for himself.

A E Cotterell Tupp took detailed notes, which included in his first lecture Sharpey's definition of his subject:

> Biology or the science of life is divided into two sub-sciences, Anatomy which deals with the structure of the body, and Physiology, which relates to its organs and their

> function... The materials of which these organs are composed are called tissues or textures and of these there is only a certain limited number and all the organs are made up of one or other of them... Histology is the science of the textures or tissues.[9]

Sharpey then continued his lectures starting with the structure of simple tissues, such as epithelium; of compound, such as glandular tissue; and then of organs, such as liver. His lectures on tissues included the purpose and qualities of each, the appearance and character, the varieties in which it was found, its constitution or structure, its location or position, its chemical composition, and its production and development. His description of organs included descriptive and general anatomy, physiology and development. Tupp's notes include references to "under the microscope" and are illustrated with numerous small diagrams of microscopical details. These were clearly copied from teaching diagrams, no indication being given of demonstrations using a microscope. Interestingly, these notes, which were bound together, have with them a loose sheet in Tupp's hand, listing the examination topics for the years 1855 to 1859, indicating topics which appeared regularly, in what seems to be an early example of "question spotting" for examinations.

George Thane's notes, taken in the 1867-68 session are not as clear and detailed as those of Tupp, indeed, in places they are rambling. This could indicate that Thane was a poor note taker, or perhaps took notes only to supplement a text, or that Sharpey was past his prime as a lecturer - he was sixty five at the time. The drawings included in the notes suggest that Sharpey, not unreasonably, used the same diagrams each year to illustrate his lectures.

Although Sharpey included details of the microscopical structure of the tissues and organs in his lectures, the students at University College had, since 1855, been given the opportunity of first hand instruction in the use of the microscope and of examining tissues for themselves. The minutes of the Medical Faculty for January 23rd 1855[10] show that the Dean, Viner Ellis, with Sharpey's approbation, had proposed the institution of a summer course of practical physiology and histology, and that the Faculty had agreed to recommend the institution of such a course to the Council together with the appropriation of funds for its establishment. A committee consisting of the

Dean, Sharpey, and William Jenner, Professor of Pathological Anatomy, was requested to draw up a statement of the views of the Faculty on the institution of the proposed course and to advise the Senate and Council "as to a suitable person to conduct the course in question"[11].

A manuscript document[12], on the cover of which is written "Remarks in relation to a Course of Demonstrations on 'The Use of the Microscope' & Chemico-physiological Experiment", appears as an appendix to the minutes. This most interesting paper, hitherto undescribed, suggests that the impetus for the proposal to establish a course in the use of the microscope came not from Sharpey, but from a demonstrator in the anatomy department of which George Viner Ellis was professor, having succeeded Richard Quain in 1850.

The document appears to have been used as a basis for discussion and has amendments and comments in another hand. The contents page is entitled "Microscopical Anatomy & Chemico-physiological Experiment". The first section of the paper had been entitled 'xxxxxxx as to the formation of such a course', and presumably contained a rationale for its formation, but the entry in the contents list has been crossed out, the first word being obliterated in the process, and the two pages on which the entry was written neatly cut from the document. The sections which follow are: Propositions as to requirements; Mode of conducting the class; The microscope & medical schools; and Conclusions. Three further sections: Syllabus of Printed Lectures; Syllabus of lectures delivered at Sydenham College; and Syllabus of lectures delivered privately in London, appear to have been added later.

The section on propositions had begun "A grant of £100, for meeting the following demands", but this had been altered to "for meeting expenses of outfit", in a less peremptory style! The requirements for the course were then listed and included from ten to twelve microscopes at seven guineas, each possessing two oculars and two objectives; sets of accessory apparatus including photographic equipment; reagent bottles and glass tubing, watch glasses and a diamond style[sic]; partitioned boxes; a grindstone, an injecting syringe and a gas jet with two roses. All this to be set up in "a quiet room, lighted from above if possible, and possessing steady tables and stools."[13] A more realistic note, in another hand, had been added to the effect that part of the dissecting room could be used in the summer for the purpose, without any interference with the class of practical chemistry. The class, it was suggested, should meet for at least an hour on five days each week during the summer term, and should do all that was presented in the annexed syllabuses. It was proposed to charge two guineas for the course, this being modified to "a low fee, say two guineas"[14], and to offer a prize for the most proficient in the class at the end of term, the constraining hand again adding "This may be deferred to the second occasion"[15].

The third section is of particular interest, since it lists each of the other medical schools in London and indicates where a similar course to the one proposed is already offered. Such a compilation indicates how important the element of competition was judged to be. St Bartholomew's, St George's, King's, the Middlesex, and the London hospitals were all, the document indicated, offering distinct courses in the use of the microscope. University College was included in the list, with the remark "Illustrative physiological, clinical & pathological courses - no separate course"[16]. In addition, the colleges in Aberdeen, St Andrew's, Edinburgh, Glasgow and Dublin were shown as offering regular courses, and, it was indicated, every provincial school in England "has a chair of histology connected with it"[17]. The list also showed that every school in Germany, every school in Paris, a number of schools in America and in India were similarly endowed.

The conclusion drawn from all this was that the London schools offered fewer opportunities, as far as the microscope was concerned, to their students than did schools in the provinces, Scotland, Ireland and abroad. Since Guy's, the Westminster, Charing Cross and St Mary's were arranging for microscopic[sic] courses in the following summer, then University College would be behind the rest if a course was not also offered there.[18]

The three syllabuses that, it was proposed, should serve as a model, were those of courses given by John Boon Hayes, Demonstrator of Anatomy at University College. This was the same man whose series of lectures on 'Histological Anatomy and Microscopic Manipulation' had been published in

The Medical Times and Gazette in 1853 and an announcement of this series of lectures was appended to the document discussed in the medical faculty meeting at University College. Boon Hayes was described as 'Lecturer on Anatomy, Physiology, and Pathology at the Sydenham College, Birmingham, and the course described as being part of that delivered to the students there.[19] The object of Boon Hayes' course at Sydenham College, was, it said, to teach the use of the microscope in its application to physiological, pathological, therapeutical and medico-juridical purposes. The course was purely practical and delivered in four sections, the syllabus for the first two of which, on the microscope itself, and upon the healthy tissues of the human body, was appended. The other two sections, on diseased tissue and the application of the microscope to diagnosis, on therapeutics and on medico-legal inquiries, were to be delivered within those departments. It is clear that Boon Hayes saw his course as one which would support all departments where the microscope could be employed.

The second syllabus[20] was for a course for those who were already practitioners, but who needed first hand experience in the use of the microscope. It included a recommendation that each member of the class provide himself with an instrument, an optician in Birmingham having been engaged to let out microscopes for hire for the course. The course included not only a section on the use of the microscope, but also on modes of preparing specimens for examination, and of preserving them. A course on general physiology and pathology would be followed by one on the application of the microscope to diagnosis, during which authorities would be quoted, so ensuring that the students became familiar with the latest views on the most important points. Indeed the syllabus referred to authorities such as Schleiden and Schwann and Paget. The document is not dated, but since Boon Hayes was advertised as having managed such a class for several years, it would appear to be one proposed during his Sydenham days, that is, between 1851 and 1853, the year in which he was first seen to be working in London. Even though Boon Hayes emphasised the practical nature of the course, he still entitled each session a 'demonstration'.

The third syllabus[21], headed "Twelve Demonstrations of the Application of the Microscope to Medical Purposes" had been given by Boon Hayes at his residence in Bolton Street, Piccadilly to practitioners in London. In what can be presumed to be Boon Hayes' own hand, he had added that the course had been attended by 17 medical practitioners in London. If this is indeed Boon Hayes' writing, then the document to which it is appended is in his hand also. The twelve demonstrations were, the advertisement said, the basis of twenty-four similar ones which had been delivered to his class at Sydenham College and also to a private class of medical men during his time in Birmingham. It is clear that Boon Hayes proposed to deliver his latest demonstrations at the same time as the series of lectures was printed in *The Medical Times and Gazette*. The course covered, in the seven physiological demonstrations: the microscope; the cellular theory; and details of the various fluid and solid tissues of the human body; and included a reference to "the microscope as a post-mortem instrument"[22]. The remaining five demonstrations dealt with pathology and the application of the microscope to such aspects as inflammation, fatty degeneration, and cancer.

Who was John Boon Hayes, who was offering such a comprehensive course? His home town was Birmingham, and he first came to London, at the age of twenty five, as a student in the 1847-8 session at University College.[23] He registered for courses in anatomy, midwifery, botany and medical jurisprudence in that session and gained his membership of The Royal College of Surgeons of England in 1848. There is no record of his taking prizes or of his being a candidate for a degree at the University of London. His first appearance in the *Medical Directory* was in 1851[24], and in the 1852 edition his position at Sydenham College was recorded, together with his qualifications of MD, King's College, Aberdeen, and MRCS Eng.[25] His last appearance was in 1855, when his post at University College, as Demonstrator of Anatomy, and his having published lectures in *The Medical Times and Gazette,* were recorded[26].

The report of the medical faculty[27] recommending to the Senate of University College the establishment of a course in practical physiology and histology, together with an explanatory statement drawn up by Viner Ellis, Sharpey and Jenner, was presented on 6th February, and then to the Council on 10th February, 1855:

> At a meeting of the Medical Faculty on January 23rd, 1855, the following resolutions were passed with respect to a Summer Course of practical physiology.
> The faculty think it most desirable that a Summer Course of practical physiology and histology as explained by the Dean, should be given in this College.
> The Faculty recommend to the Council the institution of such a course, and the appropriation, from any funds at their disposal, of the sum of money needful for its establishment.
> That a Committee consisting of the Dean, Dr Sharpey and Dr Jenner, be requested to draw up, for presentation to the Senate and Council, a statement of the views of the Faculty concerning the institution of the proposed course.
> That the same Committee be authorised to advise the Senate and Council as to a suitable person to conduct the course in question.

The statement of the Committee[28] drew heavily on the discussion document described above. It advised the Senate that the resolutions had been passed by the Faculty "with the view of supplying to the student of medicine practical instruction in physiology, and in the microscopic nature of the textures and fluids of the body". It emphasised the fact that

> if steps be not taken to introduce into the curriculum of this school a course of instruction of the kind now suggested, University College will be next Summer almost the only academical institution in London and the Provinces in which the opportunity of engaging in such practical study is not offered to the student.

It pointed out that the course would have the same correspondence with the systematic course of physiology as practical anatomy had with the course of descriptive anatomy. The "personal superintendence" of the teacher would be fixed nominally at one hour a day, five days in the week, but, the report added, the place of meeting should be accessible throughout the day to all members of the class, so that it served as a laboratory for practical physiology in which to carry out research. A grant of £100 would be needed for apparatus and microscopes to allow the course to begin in that summer.

The members of the Committee were very diffident in advising on a suitable person to teach the course, they said, lest the advice might seem to interfere with the freedom of action of the Council, but

> as the chief difficulty in establishing this practical course has hitherto been the absence of a person, connected with the College, who was willing to undertake the labour, and at the same time was able to conduct it, they may state in what way the difficulty has

> now been now overcome - Since the matter was under consideration last spring, the Medical staff has been joined by Dr Boon Hayes, a former student of the College and at present a teacher in the practical anatomy room, in whom the Committee think the necessary confidence can be placed.

Boon Hayes' previous experience was then set out, and in Viner Ellis' testimony as to his suitability as a lecturer it was added that

> Dr Hayes has the needful manual dexterity for practical teaching, and the power of conveying his knowledge to others; that he has the energy necessary to induce students to work; that he is a man of methodical and punctual habits; and that his conduct and mental endowments are such as to fit him for the post to which he is recommended by the Committee.

This report was read and adopted by the Senate at its meeting of 6th February 1855[29], and communicated to the Council as its recommendation. The Council, in turn, at its meeting of 10th February[30] resolved that the course be instituted, a grant of £100 be made, and that

> advertising be dispensed with . . . the course in question has for a long time been desired, that the want of a person connected with the College, who would be willing and able to conduct the course has prevented its establishment . . . that the College has been joined by Dr Boon Hayes, a former student of the College, as teacher in the dissecting room, and that he is quite competent to discharge the duties of lecturer or teacher.

The Senate, at its meeting of 23rd March, approved the prospectus "of Dr Boon Hayes' Course of Instruction"[31], and a search of the financial statements has revealed that in the balances for the academic year 1854-1855, there appears an item of expenditure for "Practical Physiology, Apparatus, £84 18s 4d"[32]. No record of the items purchased remains, but it is assumed that the requirements set out in the earlier discussion document formed the basis of the purchase.

The institution of the new course was of sufficient importance to be included in the Annual Report to the shareholders at their Annual General Meeting in 1855[33]. In 1856, however, the Report included the fact that

> The office of Teacher of Practical Physiology and Histology, to which Dr Boon Hayes had been appointed a short time before the General Meeting was resigned by him after the termination of his first Course last session, on his obtaining an appointment as Assistant - Surgeon in the East India Company's service. The Office is still vacant, but the applications of Candidates are under consideration.

The University College Calendar for 1855-56[34] advertised the course, the office of Teacher being vacant, as follows

> The main object of this Course is to make the learner acquainted by practical study with the intimate structure and properties of the texture and organs, and the

> characteristics of the fluids of the body, in health and disease; as well as to instruct and exercise him in the use of the microscope, and other methods practically followed in anatomical and physiological investigation.
>
> Microscopes, as well as other requisite apparatus, are provided for the use of the Class, and the room or laboratory in which the instruction is carried on will be open throughout the day.

The fee for attendance at what were termed demonstrations was £2.

In his history of University College, Hale Bellot stated that "Sharpey instituted a course in practical histology, and a Lectureship of Practical Physiology was established in 1856."[35] Taylor, in his life of Sharpey, makes no mention of Boon Hayes appointment, only that of his successor[36]. Jacyna's edition of Sharpey's correspondence with Thomson reveals no discussion of what is a very significant event in the establishment of histology and practical physiology at University College. Not surprisingly, other commentators, relying on secondary sources, have failed to mention the way in which the post was really established, and have credited Sharpey's appointment of George Harley in 1856, or even that of Michael Foster in 1867, as the initial introduction of the subject into the College.

This present research suggests that it was not Sharpey, but Viner Ellis, at the instigation of Boon Hayes, who had recently joined Ellis' department, who had first put forward the proposal to establish a course. It is possible that Sharpey had wished to initiate such a course in the previous year, but had been unable to do so unless someone, other than himself, who was already part the establishment of the College, and hence incurring no additional expenditure or establishment of a new post, could be found. That such a person, in the shape of John Boon Hayes, was appointed demonstrator in the anatomy department, was for University College a fortunate coincidence. The emphasis put on his being a former student of the College, and on the fact, not fully supported, that all other colleges had or were about to establish a similar course, suggests that a very strong case had to be made for the creation of the post.

Boon Hayes, whose rapid acquisition to and resignation from offices in hospitals and dispensaries, suggest a lack of sense of loyalty to the establishment in which he was employed, would no doubt have lost no time in proposing to Viner Ellis that he, Hayes, should teach a course in the use of the microscope. That the title of the initial proposal included neither the word 'histology' nor 'practical physiology' further suggest that he saw himself simply repeating at University College the course he had already delivered in Birmingham and London, and that Viner Ellis, Sharpey and Jenner had remodelled it to suit their own needs.

That Boon Hayes sought a post with the East India Company having barely begun the new course must have been an unpleasant shock, but perhaps not a surprise, to the College. It would have been interesting to have followed his career, but unfortunately the only reference to him thereafter was the report in the 1857 *Medical Directory*[37] of his death in Calcutta, from dysentery, in July 1856. The brief notice described him as '"formerly Lecturer on Practical Physiology at University College" and it is his part in establishing this post that renders him a significant figure.

University College lost little time in advertising the vacancy[38], and on this occasion Sharpey was directly involved in the appointment. Applications were received from Dr George Harley [1829-1896] and Dr Augustus Volney Waller [1816-1870] and on 5th December 1855 these were referred to a committee made up of the Deans of the Faculties of Arts and of Medicine, together with Jenner, Quain and Sharpey[39]. On that same day Sharpey wrote to Thomson[40]

> I wish to know confidentially what kind of person you think Dr Harley who was once one of your pupils . . . and has since been studying under Bernard, Robin & Verdril [sic] - Kölliker, Scherer & Virchow? He has applied to be teacher of Histology & Practical Physiology in our College - and as the Assistant Curatorship of the Museum happens to be vacant he is now filling that post temporarily.

The manner in which Harley came to be appointed to the museum post, an account of his student days and of his application to University College was given in some detail by Mrs Alec Tweedie, Harley's daughter[41]. Harley had gained his MD from Edinburgh in 1850 and had spent four years in French and German universities, studying histology under Kölliker and pathology under Virchow[42]

> During the eight months I passed at Würtzburg I worked in Kölliker's private room. He was then bringing out his large book on histology, and I worked *pari passu* with

> **him on the same subject. From Kölliker I learned much, also from Virchow, and thus laid the foundation of the knowledge which afterwards stood me in such good stead.**

His daughter recounted, quoting from Harley's reminiscences, that he had returned to Edinburgh in 1855 and Professor Bennett had offered him £150 per annum to assist him in conducting a class of practical physiology. Professor Simpson had though, after hearing about his work in Europe, pointed out the advertisement in the *Lancet* for the post at University College and advised him to apply for it. On enquiring at University College he had met Sharpey who sent him away to get testimonials. When he returned, on the last day for sending in applications, Sharpey helped him to construct a letter of application and himself saw that it was laid before Council that afternoon.[43] By this time Sharpey had learned from Kölliker of Harley's skills and was obviously so anxious to retain him that he asked if Harley would accept the post of assistant in the museum, which would include the luxury of having a room assigned to him at the College, until the matter of the lectureship was settled. That same evening, a Saturday, Harley received an offer of the museum post, for which an honorarium of £50 guineas a year was paid, with a request to begin on the following Monday.

The Council had decided to postpone the closing date for applications to the lectureship for three months and on 15th March 1856 the report of the committee[44], having been presented to the Senate on the previous day, was read to the Council[45]. Waller, it was reported, had in the meantime written to Sharpey, withdrawing his application "in consequence of a threatened afficion[sic] of the eye and brain from too continued use of the microscope" and the committee was "thus relieved from the difficulty of deciding on the merits of the rival candidates"[46]. No reason for postponing the appointment can be found, but it is tempting to suggest that, since neither Harley nor Waller was well known in London, a period of time was allowed during which Harley could prove himself worthy of the post. Waller was working in Bonn with the ophthalmologist Budge at the time of his application, and his key interest was the functional anatomy of the nervous system.[47] It is ironic that Harley, like Waller, suffered ill health and was later obliged to give up his work at University College because of a serious eye affliction.

Harley, then, was the sole applicant for the post of Teacher of Practical Physiology and Histology, and it remained only for the committee to report on his suitability for the post. Testimonials had been received from several eminent men, including Kölliker, who said that Harley had attended earnestly to microscopical and physiological investigations. As Harley had no experience as a teacher, it was suggested that he should be appointed, in the first instance, for a two year period, and that the course should be placed under the general supervision of the Professor of Anatomy and Physiology and the Professor of Anatomy, "with whose subjects of instruction it is most closely connected"[48].

It was reported to the shareholders that George Harley had been appointed to the post and that

> The institution of this course supplies a want that existed in our scheme of education. On the Continent this kind of instruction has been hitherto given more systematically than in the British schools, and some of the names best known there as practical physiologists are those of teachers and cultivators of this branch of Science. During the summer term this course has been conducted with a completeness that is unusual in this country; and it is not too much to hope that the students will now give attention to the subjects embraced in this course . . . [49]

It would seem that Harley himself could hardly believe his good fortune, acknowledging that at twenty six years of age, a stranger to London, and without so much as an acquaintance at University College, "then the best teaching school in London, I acquired a paid appointment within five days of my arrival in the metropolis"[50]. The post Harley filled in the following summer was certainly the first in the London medical schools to be advertised and established as a separate lectureship, others being an adjunct to some other post, in the way that Boon Hayes' had been. That the first course was largely on practical histology can be deduced from the entry in the *Calendar* for that year. His own research, though, ranged over a wide field, early work being on the anatomy and physiology of the suprarenal bodies and later researches being on the physiology of digestion, in particular of the liver[51].

A letter from Harley to the Dean of the Medical Faculty, then Jenner, dated 11th March 1857, demonstrated how he approached the teaching of the course and the relationship it bore to the series of lectures given by Sharpey. He recorded the necessity of demonstrating each physiological fact of importance by direct experiment, which demanded a considerable outlay in both apparatus and material. He also pointed out that he could only teach a limited number of students at one time. He was endeavouring, he said, to keep pace with the advancement of science, and to demonstrate every fact which the student had heard explained by Dr Sharpey. The import of the letter was that it took him many hours to prepare for his classes and that for sixty five demonstrations each of the twelve students paid only £2. He was unable to cover the cost of the course by receipt of fees, and requested that the Medical Faculty recommend to Council that the teacher of Practical Physiology and Histology be guaranteed an income of £50 a year[52].

This letter serves also as a reminder that even though the course was on offer, it was in fact accessible to a limited number of students who were both keen enough to follow it and had the funds to do so. That Harley was anxious to share his skills and enthusiasm is shown by his request, dated 28th April 1858, "to give on Saturday pm. in the Histology Class Room a short course of six lectures to medical practitioners of the new methods of volumetric analysis as applied to animal fluids"[53]. This also demonstrates that a classroom had been set aside specifically for the teaching of histology by this time.

Harley established a fashionable private practice, and in 1859 was appointed Professor of Medical Jurisprudence at University College, a post he held in parallel with that of Lecturer in Practical Physiology and Histology. This latter class increased in size so that in July 1860 Harley, seconded by Sharpey, requested an increase in the number of microscopes for the class. A grant of £50 from general funds was made by the Council for this purchase.[54] The class was still not compulsory, although in May 1861 the Council was reminded that Physiology was by then "one of the subjects of examination for the degrees of BA and BSc of the University of London."[55]

Harley held his physiology and histology post until December 1866, when he resigned "in consequence of an accident to one of his eyes incurred last year when working with the microscope"[56]. Full details of the nature of this affliction, which also caused him to resign his Chair of Medical Jurisprudence in 1869, have been given by his biographers.[57] His influence did not however end at this point, since he published a book, based on his histology classes and edited by a former student, George T Brown, which first appeared in 1868 [see below, page 283].

It was not simply changes in the anatomy and physiology departments which had an effect on the histology taught at University College. In 1862 William Jenner had resigned his post as Professor of Pathological Anatomy, on being appointed Physician Extraordinary to the Queen, and his place had been taken by Dr Wilson Fox. Fox, a former student of the College, had studied pathological anatomy in Germany and had made a special study of minute anatomy[58]. Both Fox and Harley had been appointed Assistant Physicians in 1863. It was Fox, together with Sharpey, who had taken the class of Practical Physiology and Histology during the 1865 session when Harley was too ill to teach[59].

The vacancy created by Harley's resignation was advertised in January 1867. Just one week after the advertisement, the report[60] on the three candidates for the post was considered by the Senate and almost immediately thereafter by the Council[61]. The report could show little evidence that either Mr W Handsel Griffiths, who had been a student at Guy's, or Mr Paul Henry Stokoe, who had written from Ireland, were fit for the appointment, nor were they known to the College. Dr Michael Foster [1836-1907], on the other hand, had been connected with the College from his boyhood and was favourably known to many of the Professors. He had gained the degrees of both MB and MD in the University of London, and in the course of his studentship had gained many prizes, including the Gold Medals in physiology and in chemistry. Foster had been Assistant Curator of the anatomical museum, where he was brought into

> intimate relation with the Professor of Anatomy and Physiology, who, with the greatest esteem for Dr Foster's character and disposition, entertained a very high opinion on his attainment in all those subjects which are comprehended in the teaching of Practical Physiology, and also of his capacity for conducting original scientific investigation.

The report also included details of his communications and publications. The Council was left in no doubt that Foster had been groomed for the post when the report indicated that Foster's decision to move to London from his father's practice in Huntingdon was influenced by the prospect of his possible appointment to a teachership at University College and in that position promoting and extending the study of physiology. Testimonials had been received from no lesser persons than Kühne of Berlin, with whom Foster had studied physiological chemistry; Professor Huxley; Dr Carpenter; Professor Allen Thomson of Glasgow, to whom Sharpey himself had written giving details of Foster's attributes and urging Thomson to provide a testimonial[62]; from Professor Rolleston of Oxford; and Professor Humphry of Cambridge. Not surprisingly the recommendation was that Foster was well suited for the office of Teacher of Practical Physiology and Histology, and that his appointment there could scarcely fail to extend its usefulness and enhance its importance. Council appointed Foster to the post on 19th January 1867[63].

Foster lost no time in extending the course, proposing in February 1867 to give a course of histological demonstrations in addition to that announced in the prospectus[64], and in March 1867 explaining to the Council why he wished to extend the course of practical physiology and histology and enclosing a list of instruments and apparatus which would be required to enable him to do so[65].

Foster's classes were in such demand that by April 1869, he had found it necessary to divide his class into a senior and a junior division. He sought authorization from the Council to award a further two prizes, and to allow a microscope to be given for one of the prizes instead of a silver medal[66]. The Council agreed to his awarding two medals but not to substituting one of them with a microscope!

Much later, speaking in Denver in 1900, Foster recounted his experiences both as a student and as a teacher at University College. Of Sharpey he said "He taught physiology entirely by lectures. He had no physiological laboratory . . . All he did in the way of practical teaching at that time was to show us the various tissues". Of his own experience he said, speaking of the College in 1865, "I had a small room. I had a few microscopes. But I began to carry out the instruction in a more systematic manner than had been done before. For instance I made the men prepare the tissues for themselves. This was a new thing in histology".[67]

Such was the success of Foster that in May 1869 the Medical Faculty adopted the following resolution[68] to be placed before the Senate and the Council

> That considering the position which Dr Michael Foster has attained as a man of science, as well as his successful labours and valuable services as a Teacher in this College, the Senate be requested to recommend the Council to confer on him the title of Professor of Practical Physiology and to include his Professorship in the Faculty of Medicine and in the Faculty of Arts and Laws, on the understanding that the office of teaching the class in question is not thereby created permanently into a professorship.

This was adopted by the Council on 14th May 1869. It is significant that Foster's professorship did not include histology in its title. Although Foster continued to teach histology as part of the course, it was in physiology that his main strengths lay and his colleagues could hardly have been surprised when a year later, on 30th May 1870, he resigned his post to become Praelector in Physiology at Trinity College, Cambridge.

It should not be thought that Sharpey reduced his own contribution to the teaching of anatomy and physiology as the practical teaching of histology and physiology flourished alongside it at University College. Sharpey had in addition a much wider influence on the dissemination of new work by virtue of his role at the Royal Society. In 1853 he was appointed secretary to the Society, a post he held until 1872, and a considerable amount of his time, judging by the letters he wrote[69], was spent on activities connected with this office. Probably his most influential role in this period, though, was as referee of papers to the Royal Society. Taylor has suggested that his reports do much to render apparent to us those qualities from which a considerable part of his reputation stemmed

> They are models of clarity and succinctness; they give first a penetrating analysis of the problem into its component parts, and are then constructively critical of the method by, and extent to which the author has dealt with these; and they show an impressive acquaintance with the relevant literature, demonstrably greater in many cases than the author - and this over the whole field of physiology and anatomy,

> histology, and embryology, a coverage that was maintained during a period of thirty years![70]

Taylor also expressed the rather patronising opinion that Sharpey's vast knowledge of the literature may, to some extent, have inhibited production of original work on his part.[71] As referee of papers though, Sharpey exercised enormous power over what was published by others. Sharpey also exercised control over the curriculum offered in the medical schools at that time by his membership of the General Medical Council. Sharpey rarely expressed his views in public, but in 1862, in his 'Address in Physiology' to the Annual Meeting of the British Medical Association, he ascribed the rapid advances made in physiology to the establishment of schools of practical physiology in various parts of Europe. Such schools, he said, offered opportunities for the practical study of structural anatomy, physiological chemistry, and experimental physiology. He referred to the improved methods for the inspection of phenomena, in particular by the achromatic microscope, and acknowledged the influence of the Microscopical Society, which, he said, by bringing together men "for the common purpose of promoting microscopical research . . . by spreading the knowledge of microscopical science, by its publications, has contributed in no slight degree to further the advance of physiology"[72].

By about 1869 Sharpey's sight had become very poor due to bilateral cataract and he obviously felt that the end of his career at University College was approaching. He proposed in that year to present to the College, in his lifetime, his valuable library of physiological and anatomical works, provided that proper care and accommodation were provided. With this the Council complied and directed that necessary arrangements be made.[73]

Sharpey's students too wished to create a permanent memorial to him, and a fund was raised to establish a scholarship, the holder of which should be a student of the College, and to whom duties in the laboratory of practical physiology, under the supervision of the professor there, would be assigned. In the Annual Report for 1870 the hope was expressed that it might be possible to take some steps before the commencement of the next session to the realization of the plans by fitting up a new classroom for the reception of the library, and for carrying on the studies of the class of practical physiology and histology. [74]

In the following year it was indeed possible to report not only that changes had been made to the facilities but also that, following Foster's resignation, John Burdon Sanderson would be the "able and eminent man" to whom the Sharpey Physiological Scholar would work.[75] In the same report it was mentioned that

> some recent changes in the Regulations of the University of London and of the Royal College of Surgeons which render obligatory upon all medical students the study of practical physiology, have given great additional importance to this Chair, and have necessitated modifications in the curriculum of medical studies[76].

The report added that provision had already been made for these altered circumstances, by fitting up the larger and more commodious classroom and laboratory for the students, and that further provision might still need to be made.[77]

In November 1870 Sharpey, in a letter to Thomson, remarked how glad he was that Sanderson got on well with the practical class, "He has 34 pupils - not bad for a voluntary class with rather a high fee."[78] [The new regulations were not yet in place - see below, page 287] Sharpey thought that Sanderson would also have two or three able young men working with him at research in the laboratory. Prior to Foster's departure for Cambridge, he and Sharpey had gone to Germany, visiting laboratories and enquiring into methods of instruction[79] and it must have been a considerable satisfaction to Sharpey to see not only his library properly housed, but a laboratory such as he had wished established, with so eminent a man as Burdon Sanderson to superintend it.

John Burdon Sanderson [1828-1905] had studied medicine in Edinburgh, where he had been influenced by both Goodsir and Hughes Bennett, and where he had been awarded the gold medal for his MD thesis in 1851. He had studied chemistry and physiology in Paris, there attending the lectures of Bernard, before settling in London in 1853. In 1854 he became registrar and lecturer in botany and medical jurisprudence at St Mary's Hospital, and in

1856 Medical Officer of Health for Paddington. From 1860 - 65 he was also an inspector in the medical department of the Privy Council. Burdon Sanderson was assistant physician to the Middlesex Hospital from 1863-70 and during the last four years of the period he lectured on physiology. He had been elected FRS in 1867[80].

Burdon Sanderson's chief concern, though, was physiological research and he had made arrangements with his friend Sharpey to use laboratory space at University College. By 1870 he had resigned from the Middlesex Hospital and from the Brompton Hospital, where he was physician, had abandoned his private practice and hired a room in Howland street in order to carry on with his research.[81] The vacancy at University College, with its promise of a reasonably equipped physiological laboratory, must have seemed an exceptional opportunity, and not surprisingly he became one of the candidates for the post.

Burdon Sanderson had two competitors, Paul Henry Stokoe, who had been a candidate when Foster was appointed, and Thomas Lauder Brunton, Burdon Sanderson's friend and fellow worker. The report on the candidates[82] dealt only briefly with Stokoe - "considering that he is thirty four years of age, without having achieved any physiological reputation, we are of the opinion that his claims may be at once dismissed". Lauder Brunton [1844-1916] on the other hand was only twenty six and had had a "distinguished career". The report listed the fact that he had spent the previous three years studying physiology either at Edinburgh or on the Continent, and listed his publications. He had sent in several testimonials, including one from Hughes Bennett and from such eminent men as Müller and Ludwig of Leipzig, Brücke in Vienna, and Du Bois-Reymond of Berlin.

Burdon Sanderson had sent in no testimonials, but relied upon his very high reputation and experience. The report suggested that Lauder Brunton had yet to prove himself either as a researcher or teacher, whereas Burdon Sanderson was a man of settled reputation as a physiologist, and of considerable experience. It also noted that he wished to devote himself exclusively to scientific pursuits. Burdon Sanderson was duly appointed and

Foster's title of Professor of Practical Physiology and Histology passed to him.

King's College

In contrast to the small amount of original research published by Sharpey at University College, Lionel Beale at King's College was a diligent researcher and prolific author. In his introductory lecture at the beginning of the medical session at King's in 1855, entitled "The Medical Student a Student in Science"[83], he had discussed three points which he considered important features of the study of medicine, namely: practical knowledge grounded upon experience and personal observation; previous knowledge of various branches of natural science; and the importance of original investigation. Regarding the latter, he considered it appeared

> **in the highest degree probable that all future improvement in the treatment of disease must be based upon a careful and minute investigation into its nature, which, in our country at least at present, can only be effected by the careful private study of different members of our profession.[84]**

Fifteen years later, in "Lecture on Medical Progress"[85], he reviewed his own achievements in developing facilities for students and teachers, particularly in establishing laboratories for practical and experimental work. Unlike the gradual improvements that Sharpey had been able to bring about at University College, Beale admitted that his hopes had not been realised. When he had become professor, he said, he had looked forward with great confidence to the time when a large laboratory for the study of physiological and pathological chemistry, and workrooms for thorough microscopic [sic] teaching, would be attached to the physiological department of King's College. Had these arrangements been effected, he went on, a great impulse would have been given to the scientific investigation of disease, a greater number of highly qualified teachers and new investigators would have sprung up in the school, and many new and highly important facts would have been added to science[86]. As things had turned out, in the first years of his professorship, which he held jointly with Bowman, he carried out both his own work and practical courses for students in his personal laboratory in Carey Street.

After only two years of having joint responsibility with Beale, at the end of the summer session of 1855, Bowman requested that he be allowed to relinquish his share of the physiological lectures then, instead of at the end of the following session, as previously arranged. In a letter to the Secretary of the College, he explained that his engagements now left him insufficient opportunity to devote to physiology "all the time and labour which its great extent and continual advances both here and on the continent imperatively require"[87]. He added that he was satisfied that Beale could assume the full duties of the chair, and that it would be an advantage to have a single professor who was earning a reputation among men of science and who was universally esteemed and respected by the students. The minutes of the Council Meeting at which this letter was read noted Bowman's testimony to Beale's talents and ability and the Council agreed to accept his resignation provided Beale was willing to undertake the whole duties of the Chair.[88] Two weeks later Beale's acceptance and Bowman's resignation were recorded.[89]

The *Calendar* for King's College shows that both the syllabus and mode of teaching were modified when Beale took over full responsibility for physiology in 1855. Under the heading Physiology: General and Morbid Anatomy was added the fact that

> From three to six microscopical specimens, illustrating the subject under consideration are placed under the microscopes in the Anatomical museum, every alternate day in each week, during the Winter Session, between the hours of 11 and 1, in order that every student may have an opportunity of examining for himself the structures described in the lecture.[90]

This meant that, for the first time at King's, every student irrespective of enthusiasm or financial means was able to have access to a microscope and to examine prepared slides of the various tissues. In addition, as an optional, evening course

> Dr Beale, Professor of Physiology, gives a Course of twelve practical Demonstrations during the summer session, commencing in the first week in May. In this Class instruction is given in the method of preparing tissues for microscopical examination, making minute dissections, injecting, the examination of morbid growths , of urinary deposits, etc. These demonstrations are given on Monday and Friday evenings, from 8 till 10pm. Fee for the course, 3 guineas.[91]

Significantly this course was established in the summer of 1856, at the same time that George Harley began to teach his course in practical physiology and histology at University College. It is quite possible that University College having used the example of Beale's original winter demonstrations to justify Boon Hayes' course in the summer of 1855, Beale then used Boon Hayes' course to support his more ambitious series of demonstrations in the following year. At both establishments, however, it was during the main series of general anatomy and physiology lectures that all students were introduced at first hand to the microscopical appearance of the tissues.

The conditions in which Beale worked are well described in a letter which he wrote to the Secretary, Cunningham, in May 1857 concerning the "very imperfect arrangements" for conducting his lectures.[92] He complained that the rooms were so damp that instruments rusted and dry preparations became covered with mildew, so dark that in the winter months it was almost impossible to use the microscope, so cold that it was impossible to remain in them for many hours together, and so inconvenient since every preparation has to be carried by a circuitous route to the lecture room. He pointed out the need for shelves and for a supply of water and gas. He felt that it was impossible for him to add to the efficiency of his department, and had forborne to refer to the circumstances before as he had "felt it my duty to get on with the present arrangements as well as I could for a few years, so that I could suggest to the Council alterations which would be of real and permanent value to the College"[93].

Beale had enclosed plans, unfortunately missing from the record, which showed his proposals for alterations to create a new room for microscopical work. He went on to say that he would be able to do work in the new room which at that time he carried out in Carey Street. He also offered to "take part in the necessary expenses to facilitate the carrying out of these alterations"[94].

It is not clear what decision the Council reached at that time concerning Beale's proposals, but the *Calendar* for the following year indicated that a course of about eighty lectures on "Physiology: General and Morbid Anatomy"[95] which included both experiments and the "demonstration of objects in the microscope" was prescribed for all first and second year students. The textbook used in the class was Todd and Bowman's *The*

Physiological Anatomy and Physiology of Man [96].

In the following year Beale, who had been elected FRS in 1857, gave a series of demonstrations on the use of the microscope in clinical investigation, and it was announced that "From eight to ten microscopical specimens will be shown during each demonstration"[97]. This course was open to practitioners and third year students and was given at King's College Hospital. There was no suggestion, however, that participants bring a microscope to the sessions, attendance at which cost those men unconnected with the College two guineas.

In 1868 Beale again appealed to the Council for better facilities for the teaching of physiology which, he said, had "been prospering very fast of late years"[98]. He felt that the time had come for teaching thoroughly the various subjects comprised under that head . . ."there has been a great demand for microscopical demonstrations". He reminded Cunningham that fifteen years previously he had taught such classes at his private laboratory and work rooms in Carey Street, and said that it was a matter of regret that he could not carry out this work at King's College. He pointed out that a thoroughly efficient physiological department should be established as this alone would bring many new men to the school. He then added that for some years past he had been compelled to send pupils elsewhere, and that he had been obliged to recommend some to go to University College! Having delivered this harsh comment he offered to work with the Council in the selection of a suitable site and offered to prepare a rough plan and an estimate of cost.

This carefully worded letter, with its suggestion that King's was losing students to its rival institution in Gower Street, appears to have moved the Council at least to request Beale to prepare some plans. In July 1868 he set out his requirements, which included a theatre capable of holding a hundred and fifty students and two additional work rooms, one of which was to be for microscopical work, of about thirty feet by fifteen feet, and two smaller rooms, one for instruments and the other for the professor. He included a sketch to show how such a building could be erected on the roof and how it could be well lit using skylights. With some foresight, he predicted that, since medical work was expanding in these directions, namely the increasing importance of physiology, "the demand for practical work in all branches of physiology will increase"[99].

Nothing, however, appears to have been done in response to this proposal and eight months later, in April 1869, Beale announced his wish to vacate the chair of physiology "in order that I may have more time and energy to devote to my more strictly professional labours"[100]. The lack of reasonable laboratory accommodation must have been a significant factor in his decision to resign, but to Cunningham he wrote

> this last session I had to omit some lectures and was occasionally late. My period of service has been a long one . . . the subject grows apace and is much changed in the course of ten years[101].

Hearnshaw, with hindsight, in his centenary history of the College, remarked that

> No doubt the cause of his desire to be freed from physiology was the fact that the Royal College of Surgeons at this time was beginning to insist on a practical training in that subject that involved equipment of a student's laboratory, and an immense addition to professional toils and responsibilities - a far bigger addition than any medical man in full practice could possibly undertake[102].

There was a problem for Beale in that his chair of physiology was attached to his office as physician to the hospital, a post that he wished to retain. In order to get round this problem, and also in an action which demonstrated that the Council were anxious to retain Beale's services, it was decided that the chair should be split into two, one for physiology and the other for pathological anatomy, a post that Hearnshaw described as "ornamental"[103]. Beale was offered the chair of pathological anatomy and re-elected physician to the hospital, and the other chair was advertised.[104]

First hand evidence of both content and style of Beale's teaching is found in the diary of one of his students at King's, Shephard Taylor, who attended his lectures between 1860 and 1864:[105]

> Oct 3rd. Attended a lecture on Physiology by Lionel S Beale, MB, FRS,an individual apparently not over-popular with the students, perhaps because he has a somewhat irritable temper and a finical way of lecturing besides, which is not quite to their taste. On the other hand, he is a man of great scientific ability and an indefatigable worker in the subjects that interest him.
> Oct 10th. Professor Beale's discourse on cells less interesting [than Prof. Partridge on vertebrae] having so much to do with hypothesis.

Feb 1st. Beale so enraged at the disturbance during his lecture on Physiology that he declared the microscope would be withdrawn for the future.

Oct 24th. Dr Lionel Beale gave a lecture on Physiology, abounding as usual with his pet theories about germinal matter, which seem to have little relation to the practice of medicine.

Dec 12th. Dr Beale more furious than I had yet seen him at the disturbance during the lecture, quite screaming with rage. It must be confessed, however, that the lecture was very tedious and exasperating to the audience.

May 20th. Very uninteresting lecture by Dr Beale on his everlasting theory of cell growth.

Taylor was an able student and gave a lively account, not only of Beale's shortcomings as a lecturer but also of his own experience of being examined at the Royal College of Surgeons, Royal College of Physicians, Society of Apothecaries, and at the University of London, where for his first MB he was examined in physiology by Professor Huxley and in histology by Dr Busk[106].

In his third year Taylor, who was not without money, bought himself a microscope, and thereafter included in his diary details of those materials which he examined with the aid of the instrument. It can be inferred from his account that such activities were novel and that his microscope was used at home, rather than as part of an organised College course.

Oct 26th. Went . . . after a microscope in the afternoon, buying a stand for £10 at Ladd's, Regent Street, with a mahogany case for 30 shillings and a condenser for 18 shillings.
Oct 31st. Bought a 1/4 inch object glass at Powell and Leyand's, Euston road, for 5 guineas, and at Baker's Holborn, a Shadbolt's revolving table for making cells.

Beale obviously invited the keenest young men to his own home to pursue this interest

Dec 4th. Tea-dinner at Dr Beale's, after which we adjourned to his laboratory and saw various microscopical specimens under a 1/26 inch object glass, magnifying 2000 diameters.

Taylor was undoubtedly fired with enthusiasm for the microscope and subsequent entries show that evening after evening he made fresh preparations of histological material obtained either from the butcher or from the post-mortem room at the hospital.[107]

Beale gave his own view of Taylor's account in a letter he wrote to the

Medical Times and Gazette[108]. Speaking of those students who were preparing for the examinations at the University he said

> The candidates fully appreciate and take the utmost advantage of every effort made by the teacher. The greatest interest is displayed in the examination of microscopical specimens, and the teacher naturally tries from time to time to improve his method, increase his means of illustration, and take more and more pains to interest the men heartily in their work . . . But how many members of his class aim to pass our University? The majority not being ambitious, scarcely attend to what you have to say, and in their hearts vote your efforts a bore.

The effect of the regulations for degrees in the University of London has been discussed above. It is clear, both from Taylor's diary and from Beale's comments, that at King's, as at most of the other London schools, the few students preparing for the degree were taught in the same class as those simply preparing for the less demanding examinations of the Royal College of Surgeons and of the Society of Apothecaries, a situation that would tax even the most skilful teacher.

In a letter to the same journal in the following year, Beale showed how what he considered to be inefficient examinations, such as those at the College of Surgeons, actually discouraged work and encouraged idleness

> Were it not for the small minority of thoroughly earnest students who really like work and support earnest teachers with all their heart, the task of a teacher would in these days be dismal and useless enough.[109]

It was on a similar theme that Beale lectured at the beginning of the 1867-68 session[112]. He declared then that changes were urgently required, both in the methods of examination and, in consequence, of teaching. As things were, he said "Teachers are discouraged from teaching and the great majority of students are not required to learn"[111]. He put forward a well reasoned argument for changes in teaching - "old systems of tuition can seldom be adapted to new methods of enquiry",[112] and bemoaned the inadequacies of the examining system -

> Examining boards give the teachers no information whatever upon the kind of teaching which they consider should be pursued; they will not even give us an outline of the points they consider most essential. You may conceive the inconvenience of this when many of the examiners are twice as old as the teachers . . . Most teachers, however, give a much greater number of lectures than they are required to give. Dr Sharpey has always given six lectures a week at University College, while here it is the custom to give four lectures. In all the London schools, more lectures per week are given in physiology than required by the College of Surgeons.[113]

This statement has to be considered against the ongoing debate in the medical profession about the curriculum and the examination system. It was for Beale his main opportunity to get his own concerns in print and hence contribute to the debate.

In his last introductory lecture[114] as professor of physiology at King's, in October 1868, Beale gave a powerfully reasoned justification for the inclusion of physiology in the preliminary education of all intending practitioners. There were those men, he said, who would

> leave minute research to those who are to spend their lives in scientific work and scientific investigation ... microscopic observation is slurred over in ordinary Medical education, although it would be obviously absurd to attempt to discuss the nature of changes occurring in tissues and organs without a knowledge of their structure. Practical microscopic observation is not regarded as necessary or even desirable by some who preside over us[115].

He made it clear that in this last statement he referred not only to the examiners at the Royal College of Surgeons but also to the Council at King's College - "Ever since I have had the honour of teaching in this College I have experienced the deepest concern that I have been unable to develope [sic] this branch of Professional teaching as I had hoped to have done"[116].

Beale was as passionate about the teaching and learning of physiology, including practical investigation, as he was about his own researches, to which Taylor had referred in his diary. He was a prodigious worker. Sir William Osler, in his obituary of Beale[117] claimed that between 1851 and 1858 he had published over a hundred papers [sic], "most of them illustrated with his own hand", while the *Catalogue of Scientific Papers* compiled by the Royal Society of London includes fifty-five of Beale's papers, published between 1852 and 1900.[118] The notice of Beale's retirement from the chair of Physiology in the *Medical Times and Gazette* also referred in glowing terms to his "early labours on the structure of the liver" and his series of researches into the "ultimate nature of living tissue", rather than recounting his "achievements in minute anatomy and physiology during the term of his professorship"[119].

Of Beale's published works, four groups are of particular interest in relation to this thesis: his volumes on the microscope in medicine; his series of published lectures on the structure and growth of tissues; his record of practical observations published in his *Archive*; and his lectures and monograph on the liver.

As Beale's biographer in the *Dictionary of Scientific Biography*[120] observed, his contemporary reputation derived primarily from his practical books on the microscope. The first of these was *The Microscope and its application to Clinical Medicine*, published in 1854[121]. This work aimed to show how the tissues could be prepared for examination, rather than to describe what might then be seen. Beale referred his readers to Quekett's treatise for details of different microscopes, and concentrated on microscopical technique as it pertained to the medical profession.

Following the same plan as that adopted in previous chapters of this thesis, of using the liver as a means of charting progress in the understanding of microscopical anatomy and in development of microtechnique, it is notable that scraping and smearing cells of freshly cut liver in order to demonstrate the structure under the microscope was still the norm, together with injecting, hardening and sectioning of the organ to show macroscopic and gross structure[122]. The book was well reviewed in both the general and the specialist journals. In *The British and Foreign Medico-Chirurgical Review*[123], having said that the book was, in their view, everything that could be desired in a treatise designed for practical physicians, it was stated that in the histological part of the work all the recent facts had been brought together; that the descriptions were clear, yet concise, and gave a complete outline of the whole subject of medical histology. By medical histology was meant pathological anatomy and the examination of the various body fluids and solid tissues as an aid to diagnosis.

A second and much larger edition appeared in 1858, somewhat confusingly, under the modified title of *The Microscope in its application to Practical Medicine*[124]. It had, according to the *Quarterly Journal of Microscopical Science*, been

> everywhere improved and brought up to time ... a large addition has been made to our knowledge of minute structure ... we would be glad to see a copy in the hands of every medical student and practitioner in the kingdom."[125]

The main difference is that this second edition was concerned with the investigation of healthy structures and the changes which they underwent in disease, and much that related simply to manipulation had been omitted. The section on the liver was increased from one page to sixteen pages and included specific details on the techniques for demonstrating the structure of the organ by injection. The section contained numerous references to other workers, such as Kiernan and Weber, and to Beale's own papers and monograph on the liver, and was illustrated with woodcuts. The review in the *Medical Times and Gazette* praised not only the illustrations but added that " he tells us how to use it [the microscope] and then shows us how to turn its uses to clinical account"[126]

A third edition bearing the same title as the second appeared in 1867[127]. This had been revised and nearly 100 pages of new matter added, but, in order to keep the volume to a reasonable size and price, the chapters on the healthy structure of tissues and organs had been omitted. This omission, Beale said in his preface, was of little importance, since the subject "was treated of in many other works" and would be included in the new edition of his work on the tissues.[128] The illustrations had been gathered together into plates, and the book, said Beale, could be "read" by studying the drawings with occasional reference to the text[129].

The Microscope in Medicine was the title of the fourth edition, much larger than its predecessors, which was published in 1878[130]. This volume once again included the investigation of the structure of healthy tissue. There was also a new chapter on "The colouring of tissues artificially". Beale used what he termed "the carmine fluid" to stain, using his unique terminology, "the bioplasm, germinal or living matter", which was essentially the equivalent of protoplasm, and a range of other stains to stain "formed matter", all other tissue components.[131] The relative size of these tomes can best be shown by their weight, the first edition weighing about 450 grams, the second 700 grams and the fourth 1500 grams.

The several editions of Beale's *How to Work with the Microscope,* a totally practical book, were the fruit of his series of lectures first given at King's College in the Winter Session 1856-7. In the first edition, published in 1857[133], it was, said Beale, his intention to simplify the processes for preparing microscopical specimens, and the methods for demonstrating the anatomy of the different textures, hence encouraging those with microscopes to attempt original investigation.[132] His chapters followed his series of lectures, and Beale appended the tables that he used during practical demonstrations. Table four, for example, on making minute dissections, and on cutting thin sections of tissues for microscopical examination, would have included the investigation of both fresh liver and of the injected organ. Each table was expected to take about two hours to complete. Beale also listed apparatus required in microscopical investigation. This volume was very well reviewed in the medical press. The *Quarterly Journal of Microscopical Science* felt that it could profitably insert the whole of Beale's first lecture, which dealt with the purchase of a microscope, but satisfied itself by quoting the section on *Students' Microscopes*[133]. The *Medical Times and Gazette* confidently recommended the work to those who wished to obtain accurate results from the use of the microscope[134], while *The Lancet* described it as "one of the most useful and practical works which has yet issued from the press on the subject of the microscope"[135]. It is perhaps remarkable that the book contained not a single illustration!

This situation was remedied to some extent in 1859, when a slim supplementary volume of twenty eight plates, was published.[136] The engravings were mainly diagrams showing the construction of the instrument, although there were a few showing the microscopical appearance of foreign bodies, such as chalk, which were often mounted along with the object under investigation, causing confusion[137].

Beale's second edition[138] in 1861 included "numerous explanatory illustrations". This volume was aimed at the student and "all matter that would be merely interesting to the general reader" had been omitted[139]. The *British and Foreign Medico - Chirurgical Review* remarked that "for efficient working in the clinical wards, the out-patient room, and for the proper study of histology, physiological and pathological, this little volume appears all-sufficient as an instructor."[140]

A third edition, of 1865,[141] reflected the advances in the various branches of microscopical enquiry both in Britain and on the Continent since the publication of the first edition seven years previously. The work was divided into chapters instead of lectures, but the original style was maintained. A chapter on photography with the microscope, written by Beale's friend Dr Maddox, was included for the first time. A frontispiece, a pasted-in albumen print included a variety of photomicrographs of specimens. A lens, attached to a book marker, was appended to the volume to enable the reader to see the microscopic detail shown by the print. The *Quarterly Journal of Microscopical Science* wondered "why has not photography been more extensively used to illustrate microscopic papers?"[142] The journal concluded that it was that the advantages gained would not justify the expense, but would still like to know of a photographer who would reproduce microscopic objects to illustrate their papers. Both a detailed description and an engraving of Beale's class microscope[143], which could be passed round during lectures was given. With this instrument, Beale said, he had been able to show twelve preparations magnified from 15 to 500 diameters, to a class of upwards of a hundred during an hour's lecture[144] . Beale also gave a detailed illustrated description of his own researches into growth and development, vital forces and movement, and the minute structure of tissues, especially nerves. This was a most important work.

Fourth (1868) and fifth (1880) editions were also published, the latter including over a hundred pages of new material[145]. In common with his other book on the microscope, to which this practical guide must have proved an essential companion, the editions increased in both weight and value, the first edition of *How to Work with the Microscope* weighing 200 grams, the third 600 grams and the fifth 1500 grams!

Beale's experiences as a teacher, a physician, a microscopist and an investigator, together with his skills as a draughtsman, meant that his books on the microscope opened up the world of original research not only to the student but to other practitioners. With the increasing demand for practical experience in histology by the colleges and schools themselves, and more importantly when the Royal College of Surgeons made attendance at such a course compulsory in 1870, Beale's books on the microscope would have been an essential tool, not only to students but also to those teachers who as physicians and surgeons of the hospital found themselves required to organise and teach a series of practical classes on practical histology and physiology. Other texts on the microscope, such as those by Hogg[146] and Carpenter[147], were tailored for the amateur and the natural historian respectively, and although valuable in themselves, were no competitors to Beale's works for the student and practitioner of medicine.

Beale put his microscopical skills to use in a large number of investigations into the minute structure of organs and tissues. His first paper on the ultimate structure of the liver, in 1855,[148] was communicated to the Royal Society by Francis Kiernan, whose own researches into the structure of the organ, in 1833, provided a starting point for Beale's work. His paper began with a good summary of previous work on the biliary ducts and he referred his readers to Kölliker's *Microskopische Anatomie*[149] as offering the best abstract of the views upon the structure of the liver, up to the year 1852[150]. He then described his own investigations using techniques such as injection, hardening, and sectioning, before examining the specimen under the microscope. His work suggested that a basement membrane was all enveloping of hepatic cells and biliary ducts. Beale examined not only adult livers of mammals and other vertebrates but also foetal livers. The paper was illustrated by fifteen excellent plates drawn by himself from his own preparations.

Beale gave a series of lectures on 'The Minute Anatomy of the Liver' at King's College in the winter session of 1855-56, which was published in the *Medical Times and Gazette*[151], and this series, together with his paper published in the *Philosophical Transactions* of the Royal Society in 1856, provided the basis for his 1856 monograph *On some points in the ANATOMY OF THE LIVER of Vertebrate Animals,*[152]. His lectures demonstrated, in particular, the relationship of vessels within the organ: interlobular portal canals containing branches of the portal vein, the hepatic artery and the hepatic duct; and intralobular canals containing branches of the hepatic vein. His excellent book was illustrated with pasted-in photographic albumen prints of Beale's own drawings, a method used as the cost of engraving for a small edition would otherwise have precluded the use of illustrations.[153] Beale set out his methods clearly and in detail, and included the use of mountants of differing refractive indexes. He gave a succinct account of his findings in a summary at the end of a volume, under the headings: Division of the organ into Lobules; Areolar tissue in Portal Canals; Intimate Structure of the Lobule; Of Liver Cells and of the Tubular network in which they lie; Of the finest ducts; Sacculi in the Coats of Ducts; Of the Vasa Aberrantia and of the arrangement of the Vessels around them. He concluded with a good bibliography. The *British and Foreign Medico-Chirurgical Review*[154] gave a very fair account of his findings but was cautious in endorsing them -

> we do not hesitate to say that they afford strong evidence of his doctrine; but his evidence is for the most part rather *inferential* than *direct*; and even if his facts were beyond dispute, the correctness of his deductions from them is not incapable of being called into question.

The methods Beale employed could not reveal the precise nature of the biliary ducts; they would not be finally elucidated for another century. Jacyna has discussed Beale's work on the liver in the context of the methods and concepts of the time.[155] He concluded that the structures with which Beale dealt were the artifacts of those methods and concepts, manufactured by the techniques and preconceptions brought to the microscope. It is true that Beale was a confirmed vitalist, but such an opinion denies Beale's true scientific approach to his investigation of the minute structure of tissues. It has to be said, though, that when, in 1862, Beale gave a series of lectures on the anatomy of the liver at the Royal College of Physicians[156] his ideas about structure were reiterated; and in 1871 when he again took up the question of the minute anatomy of the liver in his *Archives*[157], he maintained his original stance and contested Hering's view[158] that the structure of mammalian liver was different from that of the invertebrates and reptiles.

Of interest to this thesis, however, is the fact that at the 1862 series of lectures he "passed round"[159] a microscope to enable his listeners to see the specimens he had prepared. The *Medical Times and Gazette* listed the twelve injected specimens with which each lecture was illustrated[160]. This was the same instrument of his own design that he had described in his series of lectures at the Royal Society of Physicians, in the previous year and which he went on to describe in the third edition of *How to work with the Microscope*[161].

The first issue of *Archives of Medicine*, which Beale edited, was published in 1857[162]. The journal was subtitled *a Record of Practical Observations and Anatomical and Chemical Researches connected with the Investigation and Treatment of Disease* and was one of Beale's prime means of communicating his researches. The early issues contained his reports on both the structure of the liver and on his work on the structure of tissues.

In February and March 1861 Beale contributed a series of 'original publications' to the *British Medical Journal* on "The Structure and Growth of Tissues". In these he described his concept of cell structure, with its "germinal" and "formed" matter, and compared his view with that of Schleiden and Schwann, and with that of Huxley.[163]

In April and May of the same year he delivered a series of lectures at the Royal College of Physicians on "The Structure and Growth of the Tissues of the Human Body", which were published both in serial form by the *British Medical Journal*[164] and as a book entitled *On the Structure of The Simple tissues of the Human Body*[165]. In these he distinguished between "germinal" matter and "formed" matter on the basis of the staining reactions of the tissues to an ammoniacal solution of carmine - germinal matter taking up the stain while the formed matter did not.[166] In his third lecture Beale discussed the cell theory, read some of Huxley's paper on the subject and passed on the opinion of Virchow, "who attached the greatest importance to cells, which always come from cells". He also gave the view of Hughes Bennett, but agreed with none of them![167]

At each lecture specimens, many of which were of liver, were "sent round" in a number of Beale's portable microscopes[168]. For details of its structure, Beale referred his audience to issue No. 8 of his *Archives*, in which the instrument was fully described.[169] It is clear that he had as many microscopes as specimens for each lecture, each instrument being numbered to correspond with the number in the "Explanation of the Objects" which he circulated.[170] This means of demonstrating microscopical specimens to a group is a distinct improvement on that of either Sharpey or Quekett, both of whom had depended on the microscope moving from student to student on a fixed rail. Beale's portable instrument could be passed from hand to hand without losing its focus, thus a large number of students could observe the specimens during the course of an evening's lecture. Beale's book included good engravings showing the structure of the instrument. It is tempting to suppose that Beale developed this portable microscope not only for his public lectures but in response to the inadequate facilities for microscopy then existing in King's College.

The series of lectures was reported in detail in both the medical press and in the specialist *Quarterly Journal of Microscopical Science*[171]. The *Medical Times and Gazette* recorded that

> the portable microscopes, with lamp attached, which were passed round among the audience, excited great admiration; whilst the intensity of the magnifying powers to be employed, consisting of an 1/25 inch object glass with a magnifying power of 1700 diameters, showed that discovery has not yet attained its limits.[172]

A further series of lectures was given by Beale seven years later in Oxford. In this, while adhering to his own idiosyncratic terminology, he described the whole range of tissues found in the human body. The lectures were reported in full in the *Medical Times and Gazette*[173] and were illustrated by Beale's own drawings of his specimens.

All this research, lecturing and writing was carried on by Beale during his years as Professor of Physiology, General and Morbid Anatomy and as physician at King's College. It is not therefore totally surprising that as lecturing in the College grew more demanding, and threatened to become more so in the ensuing years, and since better laboratory facilities were denied him, he proposed to abandon his teaching of physiology for the more lucrative and satisfying practice as physician.

There is a paradox here in that for all Beale's histological and clinical work and his dedicated teaching, he failed to establish a successful, scientifically based, physiological department at King's College. Sharpey, on the other hand, whose original works were few, was able to oversee the development of a strong department.

A number of factors would have influenced this situation. The attitude of the respective College Councils to innovation was important. At University College the promotion of the College in terms of its popularity was clearly seen as vital to its success. If students were to be attracted to its medical course then the best in terms of up to date teaching and accommodation had to be provided. At King's a much narrower view was taken and financial constraints appear to have been paramount. The religious scruples of the King's' principal and of its Council would also have meant that developments in physiology and microscopical work were addressed with great caution. In addition the personality of Beale and that of Sharpey differed. The impression gained of Beale is of a diligent teacher, clinician and author, who fostered his own particular microscopical interests. Sharpey, on the other hand, maintained a wide field of contact with both Continental and British physiologists, and had time and temperament to encourage younger men to develop experimental and investigative methods, even though he did not appear to spend time on such activities himself.

Following Beale's resignation from his chair in 1869, and his acceptance of the newly created chair of Pathological Anatomy, the post of Professor of Physiology at King's College was advertised. The advertisement, dated May 24th 1869[174], indicated that the remuneration from the post, which arose wholly from the fees paid by the students, would probably average £200 per annum. Candidates were required to send in original testimonials, which vouched for their learning and skill in the physiology, their aptness in imparting knowledge, their character, and their membership of the Church of England. The date of the election was to be the 9th July.

Three men applied for the post, Dr Cobbold, Dr Gedge and Dr Rutherford. Of these, Dr Gedge, who was the teacher of histology in the Cambridge Medical School, and Dr Rutherford, demonstrator in practical physiology in the University of Edinburgh, were invited to a "personal conference" with a small appointment committee. Dr Rutherford was considered, following the meeting, to be the most suitable candidate for the appointment[175].

William Rutherford [1839-1899][176] had studied medicine at the University of Edinburgh, and had graduated in 1864, with honours and with the gold medal for his thesis. After a year as house physician and house surgeon at the Infirmary in Edinburgh, he had spent a further year on the Continent, chiefly in Berlin, at the laboratory of Du Bois-Reymond, and also in Dresden, Prague, Leipzig and Paris. On his return he had been appointed as assistant to John Hughes Bennett, who held the chair of the institutes of medicine in Edinburgh. Under Hughes Bennett, he said in his letter of application[177], he had conducted courses of practical physiology, which included lectures and practical instruction in histology and the use of the microscope, physiological chemistry, and experimental physiology. His classes, he said had been attended voluntarily by large numbers of students and had afforded him excellent opportunities for cultivating the art of lecturing. Rutherford, who was just thirty years old, was anxious to impress, and had sent a printed copy of his testimonials and a synopsis of the research he had under taken to each member of the Council of King's College. He also explained that he was at that time a member of the Presbyterian Church, but was willing to become a member of the Established Church of England. Rutherford's testimonials included a glowing one from his students in Edinburgh, with two pages of signatures appended.

Rutherford's continental experience, which he had been able to put into practice in his work with Hughes Bennett, fitted him admirably as successor to Beale. Richards[178] has pointed out that Rutherford added to Hughes Bennett's existing skills in histology and microscopical technique those of physiological chemistry and experimental physiology. He has also suggested that Rutherford's relationship to Hughes Bennett resembled that of Foster to Sharpey, and pointed out that the radical and sometimes traumatic shift in direction that physiology was taking at this time was to be the work of their younger colleagues. Unlike Foster though, Rutherford took over the entire department of physiology from Beale. He quickly discovered that at King's, no matter how enthusiastic he was, or how urgent a matter may appear to him to be, it took time and adherence to correct procedure to effect change.

Rutherford rapidly found that not only was his department inadequately supplied with equipment generally but that there was no apparatus at all for experimental physiology. He wrote to Cunningham in November 1869, pointing out that it was impossible for him to place his department "on a footing which will rescue it from the sneers that have been thrown at it" unless funds were made available. He was unable, he said, to do this unaided, as his salary was only £156 and not the £200 he had been led to expect.[179] No additional funds were apparently forthcoming since, in the following March, he wrote to the Council

> **Knowing - as I did - that my acquaintance with the methods generally adopted in Experimental Physiology and -that - my having been engaged in teaching Practical Physiology - were reasons why you had preferred me for the chair, and being, moreover aware that the neglect of experiment in the courses of Physiology generally given in London was the cause of very general dissatisfaction, I felt that I would be expected to teach physiology in a practical manner.**

Rutherford had felt unable to wait until the Council met in October and had, on his own responsibility, ordered essential instruments. He had intended, he said, to purchase microscopes without seeking a grant but his salary being less than anticipated he had had to add the cost of the microscopes to that of other instruments. He enclosed an account for £73 7s 9d[180]. The Dean, on behalf of the Medical Board, reported to the Council that "considering the exceptional character of the expence" they had resolved to recommend that the sum of £45 14s 3d be repaid to Rutherford for the instruments supplied, but that the payment of £27 13s 6d for microscopes would be deferred until the next year[181]. Rutherford therefore acquired some equipment, but was told not to use irregular methods in future. He had the double blow of a lower salary than expected out of which he had to advance money for the purchase of microscopes. Given that Rutherford was proposing to give, like Sharpey, his whole time to teaching, it was an inauspicious start to his new role.

The other London schools

The comparative luxury of having a man commit himself to the study and teaching of histology and physiology was certainly not the norm in the London schools. Private practice was lucrative and if a man was to flourish could not be neglected. Teaching, on the other hand, while it may have enhanced the reputation of both school and teacher, brought insufficient remuneration to tempt anyone to make it his life's work. The effective teaching of histology and, in particular, physiology was, in any case, becoming increasingly time consuming, and required a man to keep up with current medical and scientific literature if he was to remain abreast of the rapid developments in this area.

James Paget, at St Bartholomew's, was no exception. He resigned his post as lecturer in general anatomy and physiology in May 1859, when he told the medical school committee

> Increasing occupation in the private practice of my profession has made it impossible for me to continue either that study of Physiology without which it cannot properly be taught or that constant personal and practical teaching of the students which I believe to be one of the chief duties of the lectureship . . . I cannot anticipate that I shall again be able to devote to those duties all the time that they require.[182]

In the same year he wrote to Sir William Turner who was helping him with the second edition of his *Lectures on Surgical Pathology*

> that which I feel unable to undertake is the study of what has been done abroad since 1853, in general and minute pathology. I have only a very imperfect knowledge of what Virchow has written in "Cellular Pathology", and of what has been done, well or ill, by many . . . [183]

Paget's influence on the medical curriculum, however, was not lost. In 1865, having been elected full surgeon at St Bartholomew's in 1861, he was appointed lecturer on surgery there and was elected a member of the Council of the Royal College of Surgeons. He served on the Council for ten years, until, in 1875, he became President, and then became the Royal College's representative on the General Medical Council.

The lectureship on general anatomy and physiology at St Bartholomew's was advertised within the hospital, as was the usual practice, and William Savory was the only applicant. He was considered to be "eminently qualified and likely to maintain the credit of the school"[184].

William Scovell Savory [1826-1895][185], had been a student at St Bartholomew's, when he was the most distinguished pupil of his time. At the University of London, amongst other honours, he had won the gold medal in physiology. Savory had been both demonstrator in anatomy and medical tutor before his appointment in 1859 to the lectureship in general anatomy and physiology. He had contributed several papers to *Philosophical Transactions* of the Royal Society, of which he was elected fellow in 1858.

Marsh, his biographer, recounted that all St Bartholomew's men would remember Savory's renown as a lecturer

> In Savory's lectures style was conspicuous. He was, in fact, a born orator . . . with a correct sense of proportion, he addressed himself to the essential parts and main principles of his subject, and never descended to details which he had no time to elaborate, and which would have obscured the broader outlines which it was his object to present[186].

This slightly guarded comment seems to indicate that while Savory was a remarkable lecturer the content of his lectures did not match that of Paget. Indeed Marsh went on to say

> From one point of view, however, Savory's lectures, as well as his clinical work, were open to criticism. He looked coldly upon change, and was not at all times quite sufficiently ready to accept modern advances[187].

Savory's role did not include the teaching of morbid anatomy. Apart from that the printed syllabus[188] which Savory followed remained unchanged from that which Paget had taught, although there is no evidence to show how Savory might have modified the content. General anatomy, or, to give it the term which Savory himself used in a lecture given in 1862[189], histology, appears to have been taught, together with physiology, system by system. A demonstrator in morbid anatomy, Dr F Harris, was appointed, his title being changed to demonstrator on practical pathology in the following year.

In 1866-7, however, Savory was announced as "Lecturer in Microscopical Anatomy" concurrent with his lectureship in general anatomy and physiology, and the names of two demonstrators of microscopical anatomy were published[190], those of Dr Southey and Mr Vernon, both junior members of the hospital staff. Girling Ball, in his history of the medical college[191], stated that in 1866 it was decided that a demonstrator in microscopical anatomy should be appointed to assist Mr Savory, the lecturer in the subject, and that Southey and Vernon were elected to hold the office jointly. In the calendar for the following year a clearer picture of the situation emerges when, under the heading of "Special Departments", a course in "The use of the Microscope" was listed as being given "during the summer session by Dr Southey and Mr Bowater Vernon, under the superintendence of Mr Savory"[192]. Exactly what the motivation was for the introduction of this new course, whether by pressure from students or from other members of the teaching staff, is not clear, but it was at that time that the medical committee minutes recorded that "a sum of money not exceeding fifty pounds was voted for the purchase of microscopes" and that "The Chairman reported that five microscopes by Smith and Beck had been purchased".[193] It is significant that the purchase of no apparatus or instrument, other than the microscope, was mentioned in the entire minute book, and it can be surmised that the purchase was both innovatory and a more expensive item than was usually the case.

The role of demonstrator was undoubtedly one occupied by young men climbing the professional ladder, who were elected to the post for one or two years. Reginald Southey was replaced by Howard Marsh in 1868, and Marsh by Morrant Baker in 1869, who was in turn replaced by Richard Thorne Thorne[194]. All the demonstrators went on to obtain clinical posts in the hospital.

It was in May 1869 that Savory resigned his post, having been appointed as one of the lecturers in surgery in the school. The post of lecturer in surgery, even when shared, was obviously a coveted position and it was from Paget that Savory took over. Paget had held the post for only four years but, he wrote, "my present illness is a warning, which I must not neglect, of the necessity of diminishing my work . . ."[195].

The Medical Council took the opportunity of recommending

> that a lecturer be appointed to lecture on general anatomy and physiology as heretofore and that the said lecturer should be instructed to provide for the delivery of lectures on morbid anatomy in a manner satisfactory to the governors of the hospital.[196]

Thus at a time when King's had, albeit to accommodate Beale, separated the teaching of general from morbid anatomy, which University College had done for many years, St Bartholomew's was merging the two.

The only applicant for the new post was Morrant Baker, one of the demonstrators, who thus became both lecturer in general and morbid anatomy and physiology, and lecturer in microscopical anatomy. Thorne Thorne remained as his demonstrator in microscopical anatomy. William Morrant Baker [1839-1896][197] had, after Kirkes' death in 1864, edited the latter's *Handbook of Physiology*, which remained one of the most popular textbooks on the subject, and in consequence was well known. His first appointment at St Bartholomew's had been as assistant demonstrator on anatomy in 1863, being promoted to full demonstrator in 1865. He had also become Warden of the College in 1867. It is clear that Morrant Baker's main interest was in physiological chemistry and experimental physiology, rather than in histology. In 1870, when a new chemistry laboratory was built, together with a lecture theatre and preparation room [this was to satisfy the requirements of the Royal College of Surgeons regarding the teaching of practical chemistry], Morrant Baker requested the use of certain rooms for the teaching of practical physiology, but the request was refused[198]. Morrant Baker held his post until 1885 and was thus enabled to oversee the enormous advances which occurred in the teaching of histology and practical physiology following the changes in the requirements of the Royal College of Surgeons, soon after his appointment.

A similar pattern of movement between teaching posts of hospital staff, and of the election of relatively junior men to be demonstrators on histology, was followed in the other metropolitan medical schools.

The minutes of the London Hospital Medical College show that in 1854, the impetus to purchase microscopes and accessories came from both Carpenter, the lecturer in physiology, and Clark, the museum curator. In June 1854 instruments costing £16 11s were purchased from Smith and Beck, and in September of the same year Carpenter offered additional instruments

A communication from Dr Carpenter containing the offer of some microscopes with

> additional eye pieces to the Medical Council at 50s each having been read, resolved that three of the microscopes be purchased at the price named. Resolved that Dr Clark be requested to treat with Dr Carpenter respecting the purchase of object glasses, that Dr Clarke be requested to purchase three suitable lamps for microscopes at a price not exceeding £2.[199]

When, in 1856, Carpenter resigned his lectureship on his appointment as registrar to the University of London[200], the medical council of the London Hospital decided that the chair of physiology should be combined with that of general and morbid anatomy, that the chair should be distinct from that of anatomy and that there should be three lectures each week.[201] Clark, the salaried curator of the museum since 1853, and assistant physician to the hospital from 1854, applied for and was appointed to the new chair.

Andrew Clark [1826-1893][202] had studied medicine in both Aberdeen and Edinburgh, and was said by his biographer to have been inspired by Hughes Bennett. He held the post of professor of general and morbid anatomy and physiology for six years. He had been under continuous pressure from the council to publish a catalogue of the specimens in the museum, as was required in his role as curator, and had given strong reassurances that his duties as lecturer would not interfere with his curatorship. After nine years the catalogue was still not complete and a sight of it was requested without further delay. In December 1862 Clark wrote to the council

> The writing of the catalogue has not advanced . . . I began on too large a scale . . . I have already with much pain acknowledged that . . . the Council has had just cause for complaint . . . [203]

He resigned from both the lectureship and from the salaried post of curator, agreeing to complete the catalogue in an unpaid capacity.

Applications for the vacant chair were received from Mr Walter Rivington, Dr John Hughlings Jackson and Mr John Couper. It was decided to divide the chair between two professors and, on 22 June 1863, Couper and Hughlings Jackson were appointed for one year.[204] No record can be found of the rationale for this division of the post. John Couper [1835-1918][205] had been a pupil of Allen Thomson in Glasgow and was an assistant surgeon at the London hospital, while John Hughlings Jackson [1835-1911][206], an assistant physician, had been a pupil of James Paget at St Bartholomew's. No record exists either, of the course or courses offered by these two young men. The minutes of the medical council of the college reveal, however, that in April 1865 Hughlings Jackson "resigned his post in the lectures on histology"[207] and in consequence Dr Clark, who was still a member of the hospital staff and a member of the council, and Dr Sutton "be associated with the lectures in physiology in the summer course on histology". The council also accepted Clark's offer of help with the current course of practical histology. It is clear therefore that a separate course of practical histology was taught in the summer session of 1864-5. Henry Gawen Sutton had studied at both King's and Guy's medical school. He was appointed pathologist to the London hospital at the time of the cholera epidemic of 1866 and elected assistant physician in 1867[208].

When Couper resigned his share of the lectures in 1866, Dr Morell MacKenzie, the only applicant, was elected to replace him.[209] MacKenzie [1837 -1888][210] had been a student at the London, and having studied in Paris and Vienna, had returned to take both the MB and MD of the University of London. He was elected physician to the London hospital in 1866. MacKenzie remained in his physiology post for three years, resigning in June 1869.

The prospectus for 1868-9 shows that Hughlings Jackson and MacKenzie were jointly responsible for lectures in the winter course on physiology and general and morbid anatomy[211], and that in the summer they again shared the course on "Practical Histology and the Use of the Microscope in Diagnosis". This course, which was free to both the past and current pupils, embraced methods of investigation and preservation of the tissues and organs of the body in health and disease, and the clinical examination of body fluids etc. The prospectus indicated that a cabinet of microscope preparations was open to the students[212]. In that same summer MacKenzie gave a short course of lectures on diseases of the throat and Dr Sutton gave "a special course of lectures on pathology"[213].

When MacKenzie resigned his place was taken by Dr Samuel Fenwick [1821-1902], who had been appointed assistant physician to the hospital during the previous year, having had until then a large general practice in Newcastle.[214] Fenwick joined Hughlings Jackson in the winter course of lectures, but the latter alone taught the practical course in the summer of 1870.[215] Hughlings Jackson had written to the council resigning his chair in November 1869 and shortly afterwards the council decided that a chair of pathology and morbid anatomy should be established, and that in consequence the words "and morbid" would be omitted from the title of the physiological chair.[216] It was to this modified post that Dr William Bathurst Woodman [1836 -1877] was appointed, being the only applicant, in June 1870. He too had been a student at the London, and, like Fenwick, had gained an MD at St Andrew's. He had held house appointments in the London Hospital and was elected assistant physician in 1870. Clark - Kennedy, quoting the minutes of the House Committee, points out that it was in 1869 that a room was fitted up in which students could "learn to use the microscope"[217]. It seems likely that, being the person in post for some time, Hughlings Jackson would have been the instigator of this innovation.

With the continual changes in lecturers and the election to the physiology posts of newly appointed assistant physicians and surgeons, with virtually no competition, there was no established voice for physiology on the council. In fact when Woodman was elected, far more space was given in the minutes to the discussion on the cost and supply of extra eggs in the hospital, that to the filling of the vacancy![218] It is hardly surprising that when the matter of the new regulations of the College of Surgeons, with regard to practical physiology, was raised by the Dean[220], the discussion on the best method of meeting them had to be deferred until the new lecturers, neither of whom had been involved in teaching of physiology until their recent appointment at the London hospital, had expressed their views.

The practice of appointing inexperienced young men to lectureships was not confined to the London Hospital School. At Guy's, in 1859, the practice was identified as one which contributed to the decline in popularity of the school. The treasurer, Thomas Turner, had written to each member of staff, inviting suggestions as to how the position could be remedied. Many of the responses identified the lack of scholarships and prizes, and the lack of a collegiate system for the decline in numbers; the establishment of University College and King's College was also cited, but the majority blamed the method of appointing lecturers and quality of the instruction given by them.[220] Gull, who had by that time resigned his post as lecturer in anatomy and physiology to Pavy, said

> The elections should be more open - whilst the preference might and should always be given to a 'Guy's man' it should not I think be understood that Guy's never refreshes itself with new blood however good. It is notorious that exclusiveness in educational establishments leads to degeneracy - Guy's men would put forth more power if it was felt they had to compete . . . In the appointments to the different lectureships too little regard has often been had to fitness . . . one is often obliged to hold one lectureship in order to gain another, it being tacitly understood that such an ordeal is necessary for promotion.[221]

This was echoed in other responses, where the desirability of a lecturer remaining in one post for some time and thereby becoming a specialist was also recommended.

Frederic William Pavy [1829-1911][222] had followed just such a path as Gull described. He had been a student at Guy's, and having graduated from the University of London in 1852, had served as house surgeon and house physician at Guy's, before going to Paris where he studied under Claude Bernard. He had returned to Guy's in 1854 to become demonstrator in anatomy and lecturer in comparative anatomy. Two years later he became lecturer in anatomy and physiology, and in 1858 he became assistant physician and lecturer in clinical medicine. In 1871 he was raised to the status of physician and lecturer in medicine. Pavy was an exponent of the scientific approach to medicine and it was for his work on metabolism and on diabetes rather than for his teaching that Pavy gained a wide reputation.

The teaching of minute anatomy was part of the course on anatomy and physiology, but in 1867, at the meeting of the education committee of the medical school it was thought "advisable that the instruction of the students in the use of the microscope should take the shape of practical instruction in the use of the instrument"[223]. This instruction was undertaken first by first Durham and then by Howse. Arthur Edward Durham [1834-1895][224] was said to have been a brilliant operator and had been elected assistant surgeon in

1861, the year in which Henry Greenway Howse [1841-1914][225] had entered Guy's as a student. Howse, having gained the London MB in 1866, was appointed demonstrator of anatomy in 1868, at which time he took over the instruction in the use of the microscope from Durham. He was elected assistant surgeon in 1870, when he relinquished this teaching to Pye-Smith.

It should not be thought that the microscope was not in regular use in other departments. Its use in morbid anatomy was fostered by Walter Moxon [1836-1886][226], who had been a brilliant student at Guy's, appointed demonstrator in anatomy before graduating in 1859, and continuing in that post until his election as assistant physician in 1866. He then went on to lecture in comparative anatomy, pathology and materia medica, and, from 1882, nine years after his promotion to physician, in medicine, in succession to Pavy. Wilks and Bettany record how Moxon used to go home laden with pathological specimens for microscopical examination, at which he would work late at night and in the early morning, producing a magnificent series of pathological drawings.[227]

Appointments to the staff of neighbouring St Thomas's hospital and school were not however confined to former pupils. William Brinton [1823 - 1867], who in 1854 had joined Grainger in teaching physiology, had been a student at King's College.[228] He had become physician to St Thomas's in 1858 and when Grainger retired in 1860, at a time when a complete reappraisal of staffing was undertaken, Brinton took over responsibility for physiology. In his introductory lecture in October 1860, in reference to microscopical anatomy he said

> So great is the mass of details accumulated of late years on this subject, that its full consideration would alone occupy twice the time placed at our disposal by the Examining Bodies for the whole physiological course . . .

He recommended his students to confine their attention to the "cursory descriptions" given in the lectures but to take every advantage of the demonstrations of Rainey "one hour of whose practical teachings you will find of more value . . . than any number of books or lectures"[229].

Brinton resigned his position as lecturer on physiology in 1863, on account of the pressure of his private practice[230]. The Grand Committee of the hospital, however, would accept neither Brinton's sharing the post nor his relinquishing it, since, they said, they considered his appointment as physician had special reference to his connection with the school as lecturer in physiology[231]. In the following February, after a period of absence "due to overwork", Brinton requested the help of Dr Ord, lecturer in comparative anatomy, in giving the lectures, and again this was refused.[232] In the following November thirty students wrote to the lecturers committee, requesting some arrangement that would better suit Brinton and thus secure his regular attendance.[233] At this point Brinton resigned not only his post of lecturer but also his office as physician. His health, Brinton said, was worn down in struggling to do what was almost impossible. The names of Ord and Bristowe, a physician who had been curator of the museum, were recommended to the treasurer and the Grand Committee who agreed a joint appointment in November 1864, as a temporary measure[234]. This arrangement for the teaching of physiology, together with Rainey giving demonstrations in microscopical anatomy continued until the 1870-71 session.

It is not hard to imagine the poor quality of the teaching in physiology and histology at St Thomas's, with weary staff, a paucity of instruments and accommodation, temporary posts, and an unsympathetic administration.

The students at St George's on the other hand received fairly consistent tuition. The annual entries in *The Lancet* show that Mr Athol Johnson continued to teach physiology, general and comparative anatomy throughout the 1850s. The prospectus for the 1857-8 session indicates that at some stage in his lectures he dealt with "the structure and properties of the different tissues", and that Dr Ogle gave a series of demonstrations under the heading "Microscopical Anatomy" during that winter session.[235]. This practice continued until the 1861-2 session when Ogle taught pathological and morbid anatomy in addition to demonstrating microscopical anatomy. In 1662 he took over Johnson's lectures.

William Ogle [1827-1912], an assistant physician, had entered St George's as a student at the age of twenty six, having gained a first class BA degree in natural sciences from Oxford, where his father was Regius Professsor of Medicine, and having taken holy orders.[236] He then went on from St George's to gain his MB. He continued his all embracing role in anatomy and physiology at St George's following Johnson's resignation until, in 1867, a paid demonstrator in "histology and the elementary facts of physiology" was chosen from amongst the senior students[237]. This post went, in successive years, to Williams, Bright and Sims. Ogle continued in his lectureship until 1872 when he retired due to ill health. The fact that Ogle lived for a further forty years in retirement, devoting himself to translating the works of Aristotle, suggests that he was not prepared to face not only the changes which inevitably took place following the Royal College of Surgeons revision of their regulations with regard to practical physiology, but also the necessity of keeping up with a subject which was becoming increasingly complex.

The practice of introducing students to practical histology and the use of the microscope through the services of a demonstrator was also followed at the Middlesex hospital medical school. There, though, a demonstrator was not selected from amongst their own students but from outside the school by personal recommendation. In July 1852, Mr Nunn, the demonstrator in practical anatomy agreed to take over the anatomy department provided that Dr Van der Byl "a gentleman from the University of Edinburgh . . . whose testimonials from Professor Goodsir and others are all that can be desired" could be brought in to assist him.[238] Philip Van der Byl, who had been awarded honours and the gold medal in the MD examinations at Edinburgh[239], was appointed and at the end of his first year as demonstrator in anatomy, in 1853, the Committee of Lecturers resolved that "a sum not exceeding £15 be allowed for the fitting up of the small room adjoining the dissecting room for the purpose of carrying on a class of Histology under the supervision of Dr Van der Byl."[240] The main lecture course in physiology and general anatomy was carried on by Campbell de Morgan, but in 1855 Van der Byl suggested that his duties in the dissecting room be taken over by Mr Flower and that he, Van der Byl, be formally constituted lecturer in histology.[241] His proposal was discussed at the general meeting of the officers and lecturers, and it was agreed that "Dr Van der Byl be appointed Lecturer in Histology, the duties of the office to be distributed . . . between the winter and summer sessions."[242]

Van der Byl continued in this position until 1858. When he indicated his intention of resigning, the secretary of the lecturers committee said that he had "been in communication with Dr Webb who was willing to undertake the duties of lecturer in Histology and minute anatomy", although he wanted them to be delivered twice each week during one three month session, rather than spread over two sessions[243]. Dr Woodham Webb had delivered lectures on histology and the microscope at Lane's school in Grosvenor Place for the previous two summer sessions, and so was known in the circle of medical teachers. It is interesting that the post was considered important enough for him to be chosen, and paid £1 per student from the general fee at the Middlesex, rather than one of the school's own students. Webb, however, was not happy with his position. He said that he was unable to give a proper course of histological demonstrations to the number of students now attending. His view was that as out of the number attending only a few worked steadily at the course, it would be better if the demonstrations should be given to some selected students only, and that the course should extend over one month only.[244] It was decided in consequence that an assistant demonstrator should also give some elementary instruction in histology.

When in 1866 De Morgan was nominated as joint lecturer in surgery, and vacated the chair of physiology, Dr Burdon Sanderson and Mr Hulke were nominated as joint lecturers in his place[245]. At that time Hulke was an assistant surgeon and Burdon Sanderson an assistant physician, who also lectured in pathology and morbid anatomy. John Scott Burdon Sanderson [1828-1905][246] had studied medicine in Edinburgh, where he was awarded a gold medal for his thesis in 1851, and had studied chemistry and physiology in Paris before settling in private practice in London. He had held posts at St Mary's Hospital and the Brompton Hospital and had been medical officer of health for Paddington since 1856. Burdon Sanderson's concept of physiology, which contrasted sharply with that held by Beale, was expounded in his introductory lecture in physiology in 1868 when he said

The fundamental idea in Physiology is this: that the same laws which prevail in

> inorganic nature prevail also in the living organism; that the causes or forces which operate on matter outside the body, and bring about its movements and changes, operate precisely the same way in the body. The result of this is that when you begin to study physiology, already knowing the laws of physics and chemistry, you have merely to apply those laws under new circumstances.[247]

Webb worked with Burdon Sanderson and Hulke until 1868 when his post as lecturer in histology passed to Dr Cayley, who had himself succeeded Burdon Sanderson in the lectureship in pathology. William Cayley [1836-1916][248] had been a student at King's and had studied pathology in Vienna before becoming a demonstrator at the Middlesex hospital. Cayley continued to teach pathological anatomy until he was promoted to full physician in 1876, but surrendered his lectureship in Histology when the course was transformed in one of practical physiology in 1870.

Neither Hulke nor Burdon Sanderson remained for long in the physiology post, both resigning in 1870. Clearly Hulke did not intend to continue as a lecturer since he gave all his diagrams to the school on his resignation.[249] Burdon Sanderson, on the other hand, gave up his hospital appointments and decided to devote himself to physiology and pathology.

The physiology post at the Middlesex was advertised and Dr Ferrier was appointed to the lectureship in 1870.[250]

Such movement from hospital to hospital and from chair to chair was by no means unusual, and to this movement Charing Cross Hospital medical school was no exception. Wharton Jones had resigned his appointment as lecturer in anatomy and physiology there in 1850, when he was appointed ophthalmic surgeon at University College Hospital[251]. In April 1851 Francis Hird, then lecturer on practical and surgical anatomy at Charing Cross, was appointed to the chair of physiology, but resigned in 1852 to take lectures in midwifery and medical jurisprudence[252]. His place was taken by Edwin Canton, the lecturer in practical and surgical anatomy.

It was in 1853 that the description of the post changed, so that the words "physiology and pathology" were substituted in the prospectus for "general anatomy and physiology"[253]. At the same time Canton was asked to teach anatomy in addition to physiology for the ensuing winter term. After one term Canton, not surprisingly, felt unable to continue

> Having performed during the last session the duties of the Chair of Descriptive and Surgical Anatomy in addition to those of the Chair of Physiology, which I also then occupied. I beg to state that I shall for the future find these combined duties too onerous to be satisfactorily fulfilled and that being desirous of retaining only one of these chairs, I should prefer that of Descriptive and Surgical Anatomy and am desirous, therefore of resigning the one on physiology.[254]

He was consequently reelected to the chair of practical anatomy.

It is difficult to see how either physiology or practical anatomy could have been well taught in such circumstances, with constant movement from post to post. The School Committee had obviously failed to find anyone willing to take on the physiology from within the school, and so the post was advertised in the medical press and in *The Times*,[255] and Dr Hyde Salter was appointed to the chair[256].

Henry Hyde Salter [1823-1871][257] had been a student at King's College and in 1850 had been appointed demonstrator of anatomy there, and assistant physician to King's College Hospital. In 1851 he had gained the MD of the University of London. At King's he worked closely with Todd. He was the assistant, i.e. working editor of Todd's *Encyclopaedia of Anatomy and Physiology* to which he contributed several articles. That on the tongue, describing for the first time the microscopical arrangement of the intrinsic muscles of the organ, contributed to his election as FRS. Salter was also concerned with the production of the fourth part of Todd and Bowman's physiology text. He was at the time it was written, prosector to the class of physiology at King's and, said his obiturist,

> nearly all the physiological experiments and microscopical preparations illustrative of the subjects in that part of the work (digestion and circulation) as well as the great majority of the original drawings were by him[258].

He failed to succeed Todd in the chair of physiology at King's and transferred his allegiance to Charing Cross Hospital.

Hyde Salter lectured in physiology at Charing Cross from 1854-1864 and provided there, for the first time since Wharton Jones, consistent, knowledgeable teaching in physiology. It was in 1858 that Hyde Salter began to give a short course of microscopical demonstrations in the summer term, the course being free to matriculated students.[259] As a teacher he was said to be painstaking, energetic and popular. He had become an assistant physician in 1855 and became a full physician in 1866. It was in this year that he transferred from the chair of physiology to that of medicine and the chair of physiology became vacant once again.

In May 1866 Dr Morris Tongue offered himself as a candidate and was appointed.[260] He served for only one session, but, according to the details given in *The Lancet*, gave a course of practical microscopical demonstrations on healthy and diseased structures. In February 1868 Dr Claye Shaw was appointed to succeed Tongue, but he declared himself, "due to unforseen circumstances" unable to give the complete course of lectures in physiology that year. Dr Alexander Silver, lecturer in forensic medicine, stood in for him[261]. In March 1869, at a time when other schools and colleges were recognising the increasing importance of the subject, the Dean of the Charing Cross school wrote to Claye Shaw to express regret that he had neglected to give any lectures in physiology during the winter term. The Dean sought a distinct undertaking that he, Claye Shaw, would fulfil his duties in the future.[262] Claye Shaw's response was to resign. Dr Silver then transferred from forensic medicine to the vacant chair in July 1869. Silver continued to teach the summer course of microscopical demonstrations, and purchased two microscopes from Paris for the school in 1870[263]. Plans were also formulated at this time for the building of a physiological and pathological laboratory.

Little evidence remains of the courses on histology at the Westminster Hospital school at this time, except for the annual listings in *The Lancet*. From these it is clear that it was not until the 1854-55 session that physiology and general anatomy was separated from descriptive and surgical anatomy. The physiology and general anatomy was taught by William Hillman, an assistant surgeon to the hospital, who had been teaching anatomy and physiology since 1849. He was succeeded by Henry Power in 1859. Henry Power [1829-1911][264] had been apprenticed to the apothecary to St Bartholomew's hospital and entered as a student there in 1844. He earned a living after qualifying by coaching young men for London University scholarships. In 1857 he had become assistant surgeon to the Westminster hospital, and lectured first in comparative anatomy and then, in 1859, in physiology. Power went on to become an examiner in physiology at the University of London and a member of the Board of Examiners in anatomy and physiology at the Royal College of Surgeons. He was engaged in a range of literary work throughout his life; in 1870 he translated Stricker's *Manual of Human and Comparative Histology*[265], and from 1864 -1876 he edited the sixth, seventh, eighth and ninth editions of Carpenter's *Principles of Human Physiology.*[266]

In the 1868-9 session Duncan Maclure[267], who had been a student at the Westminster hospital and was then its medical registrar, was appointed to the physiology chair, following Power's election as ophthalmic surgeon at St George's hospital. Maclure taught a distinct course on histology and practical physiology at the Westminster school. A separate short, free course of microscopical demonstrations had been given by one of the surgeons, Mr Brooke, since 1861, and these carried on in parallel with Maclure's courses into the 1870s.

Despite the competition for students between the various colleges and schools, a new one, St Mary's Hospital Medical School, opened its doors in 1854. It advertised its list of lecturers[268], all of them members of the clinical staff, in the medical press, and attracted in its first year fewer than twenty students[269]. The lecturers included Dr Charles Handfield Jones and Mr Samuel Lane who taught anatomy and physiology and Dr John Burdon Sanderson who taught medical jurisprudence and botany. The Dean was Henry Spencer Smith, a surgeon, who had in 1847 translated into English the works of Schleiden and of Schwann[270].

Handfield Jones, however, whose papers on the structure and development of the liver had been read before the Royal Society, and who, in 1854, together with Sieveking, who lectured in materia medica, had published *A Manual of Pathological Anatomy*[271], resigned his post in 1856, "no longer finding the discharge of his duty compatible with the preservation of his health"[272].

The initial equipment of the medical school had not included a microscope, but in October 1856 the Medical School Committee resolved that "a microscope be provided for the use of the school as early as funds will permit, and that measures be taken for securing proper light for the exhibition of microscopical objects in the dissecting room"[273]. In the following year the dean not only presented a microscope, but also paid for the new window in the dissecting room[274].

When, in 1858, Lane resigned his part of the anatomy and physiology teaching, the two areas of physiology, general and morbid anatomy, and of descriptive and surgical anatomy were separated. Dr Markham, who had been giving some lectures on pathology was appointed to teach the physiology.[275] It was not until 1861, however, that a distinct course of microscopical demonstrations was given, this by Burdon Sanderson as a private enterprise[276]. Later that year Markham resigned and Dr William Broadbent, a physician at the hospital, was appointed to teach physiology in his place.

Cope has described Broadbent as seeming to be

> equally at home in that subject as in the many other subjects which he, from time to time, taught. Comparative Anatomy, Pathology, Physiology; and even Midwifery, all seemed to come within his province, quite apart from his purely clinical work.

Cope went on to quote Broadbent in a letter written in June 1861[277]

> I have worked hard this spring and summer. My appointment to the Lectureship in Comparative Anatomy was made only a few weeks before the opening of the session, and as I was just at that time trying for the London Fever Hospital, I had no time to prepare my lectures beforehand and I have had to do it from day to day. I have recently been appointed Lecturer on Physiology so that the recess will be fully employed in getting ready for the winter session.

This could only have been an unsatisfactory arrangement, as Broadbent, however versatile and industrious, could not have taught an effective course in such circumstances.

In June 1864 Dr Lawson of Queen's College, Birmingham, wrote to the dean offering his services to the St Mary's school. The dean raised this with the medical school committee, where, it seems, the teaching of practical histology was under discussion[278]. A sub-committee was appointed to consider the teaching of histology in connection with Lawson's letter. They decided

> 1st - that there is a need for the improvement of the teaching of practical histology in the school

> 2nd - that the need may be satisfactorily supplied by the institution of a course of demonstrative lectures on that subject . . .
> 3rd - that Dr Lawson's qualifications eminently fit him to supply what the committee considers to be a serious deficiency in the course of teaching pursued in the school.

It should be remembered that until this point the school had been served by officers of the hospital, and some debate followed about a means of remedying the deficiency without cost to the school[279]. Eventually it was decided that a co-lecturer should be appointed with Dr Broadbent and that applications for this post should be sought[280]. The sub-committee recommended that "six lectures on physiology be delivered each week, four on physiology proper by Mr Broadbent and two by a co-lecturer on histology, chiefly by demonstration"[281]. In July 1865, Dr Lawson was selected from a list of three applicants.

Henry Lawson [1841-1877][282] had received his medical education in Ireland at Queen's University. He was keenly interested in histology and edited the *Monthly Microscopical Journal.* The class at St Mary's appears to have been well equipped before his arrival, since at the annual distribution of prizes in 1865, the dean had reported that a microscope class had been added, where all the students were taught practically at the table how to use the microscope, "each man having an instrument before him".[283] Lawson seems to have lost little time in effecting further change in the department, however, since in November, 1865 expenditure was authorised for fittings necessary for the use of the histological class[284]. Lawson was appointed to the clinical staff of the hospital in 1866. He gradually took over parts of Broadbent's role and was assisted in the histology course by both Henry Charlton Bastian, and Frank Payne, lecturers on pathology. Lawson finally took over the physiology lectureship from Broadbent in 1871.

This detailed account of the circumstances and personalities concerned in the teaching of histology in the 1850s and 1860s in the London schools, shows that the men involved did their teaching while holding a clinical post and usually also while carrying on a private practice, with the notable exception of Sharpey at University College.

There was an accepted career pathway in the hospitals, with a gradual movement from a junior house post to that of full physician or surgeon. This progress was mirrored in the schools where men progressed from assistant demonstrator, through the post of lecturer in general anatomy and physiology, to lecturer in medicine or surgery. In pursuing promotion it was not unusual for a man to move from one specialism to another, or to lecture in a number of areas of the curriculum at the same time. Such movement, often with little notice, could only mean that inadequate preparation was made for a new post, and that insufficient time was spent in it to amass relevant drawings, instruments and specimens.

In some schools only former students were considered for a post. This meant that, although some men had also pursued their studies elsewhere, there was little enrichment from practice in other establishments and the pool of expertise outside remained untapped.

Unlike the position of their colleagues on the Continent, only exceptionally would there be facilities for pursuing research into some aspect of histology, although a few men, such as Beale, were able to establish their own laboratories, and had sufficient energy not only to practise and to teach, but also to carry out research and publish their findings. But even Beale gave up his physiology post. "How strange it seems at first sight" the editor of *The Medical Times and Gazette* remarked on Beale's resignation from his chair at King's[285], "that a teacher of this master science, in the prime of life and activity, and zenith of his well earned reputation, should throw up a chair at one of the first schools in London". The reason, he went on was not far to seek

> A Physician who has to make his way in the London world cannot do so as a physiologist. Physiology not only does not lead to practice and fees, but it does not obtain the reward due to itself, nor even the opportunity of work . . . But if physiology does not bring in money, neither can it, under the existing arrangements, bring fame, and it does not give the professor the opportunity of fully teaching and of enlarging the science he teaches.

The importance of the microscope in medicine, however, was recognised. Most schools established a course, usually only of demonstrations, on the use of the instrument. Such a course was optional, however, and did not replace the teaching of histology, usually in conjunction with physiology, as general anatomy. Even at University College and King's College, where specimens were passed round during the lectures, few students had any first hand experience of using the microscope, and at University College, Sharpey waited until Boon Hayes joined the college before establishing a genuine practical course.

Textbooks

A range of textbooks was available to support the teaching and learning of histology. If a teacher lacked microscopical skills himself there were good textbooks to enable him at least to tackle the delivery of a series of lectures. More general texts on both anatomy and physiology would have supported the student's learning and complemented the lectures and demonstrations. The texts, in their later editions, which supported the courses at University College and at King's College would no doubt have been readily available to both London teacher and student.

Sharpey had re-written the section on general anatomy in the fifth edition of Quain's *Elements of Anatomy*[286] in 1848, and he revised it in 1867 "adapting it to the present state of science" for the seventh edition[287]. This edition had many new figures, some from Kölliker[288] and others from Frey[289]. The section on descriptive anatomy was edited by Sharpey's former colleague Allen Thomson and by John Cleland, who had been Thomson's assistant in Glasgow and was then professor of anatomy at Queen's College, Galway. The production of this seventh edition of the "weary Quain's Anat^{y}" was the subject of much discussion between Sharpey and Thomson, in particular Sharpey felt that illustrations were needed if the book was to have a fair chance of sale with competing publications.[290] The section on liver was well illustrated and still included diagrams of longitudinal sections of the organ "after Kiernan", thirty four years after their original publication[291], together with more recent figures showing the capillary network in the lobules and of separate hepatic cells from Kölliker, and of biliary ducts from Kolliker after Beale[292].

Another student text, Hughes Bennett's *Outlines of Physiology*[293] was published in 1858 as an accompaniment to his lectures. The first part of the

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Figure 7.
L S Beale - *On some points in the anatomy of the liver of man and vertebrate animals.* London: Churchill, 1856.

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volume dealt with "histological physiology" and included a description of the tissues.

Gray's *Anatomy, descriptive and surgical*[294] was published in the same year and gave "a brief account of the microscopical anatomy of some of the tissues, and of the various organs"[295]. In his first edition Gray based his description of the anatomy of the liver on that of Kiernan, while in the second edition[296] the views of Beale, Henle, Handfield Jones and of Kölliker were included. In the fifth edition of 1869 the general anatomy, which in previous editions had been scattered throughout the book was gathered into an introductory chapter. Gray's aim, he said, was

> not to go minutely into the more recondite and more dubious parts of microscopic research . . . to provide the student . . . with a plain account of things for the most part universally admitted, and which with moderate pains, he can succeed in demonstrating for himself[297].

He acknowledged the fact that all his illustrations for the chapter on general anatomy he had borrowed from the English translation of Kölliker, from Todd and Bowman and from Harley and Brown.

The text of Todd and Bowman, *The Physiological Anatomy and Physiology of Man* was completed in 1857, fourteen years after the first part was published[298]. Beale had given them "very important assistance" in writing the final chapters of the tome[299]. In the section on liver Kiernan's illustration of a longitudinal section of the hepatic vein was still reproduced[300] but the main feature was the series of illustrations taken from Beale's recently published monograph on the liver[301] [see fig 7]. Indeed it was these "photographic representations" which elicited comment in the review of the text in *The Lancet*[302], while in that in the *Medical Times and Gazette* the description of the minute structure of the liver by Beale was noted as a feature "of especial interest"[303]. In 1866 Beale produced the first part of an entirely new edition, adding his name as joint author to that of Todd and Bowman on the title page[304]. The book was well received. It was applauded for presenting, in contrast to the work of Kölliker and that of Carpenter "a scientific and lucid exposition of the minute anatomy combined with the physiology of the tissues". Both the review in *The Lancet*[305] and that in *The British and Foreign*

Medico-Chirurgical Review[306], however, commented on the fact that, in this edition, Beale had introduced his own views and terminology on the structure and development of cells. In *The Lancet* Beale's views were described as "peculiar", and having said that "we do not here desire to enter the lists with Dr Beale", went on to do just that![307]

Not surprisingly Beale did not report the views of Virchow on the origin of cells in the introductory part of his text. It is possible, however, that teachers and some students of histology and morbid anatomy in the London schools had already come across Virchow's *Cellularpathologie*[308] when, in 1860, a translation into English by Frank Chance of the second German edition[309] was published. Virchow had first outlined the hypothesis on which his cellular pathology was based in an essay in 1855, which bore the same title as his book, published three years later. It was that

> all diseases are reductible to active or passive disturbances of living cells; all cells arise from other cells, *omnis cellula e cellula;* the functional capacities of cells depend on intracellular physical and chemical processes and may to some extent be inferred from structural changes of cells; all abnormalities of structure are degenerations, transformations or repetitions of normal structure[310].

The profound influence of Virchow's teaching on medical thought has been examined in detail elsewhere[311]. For this present thesis we must only highlight the fact that Virchow had done more than simply reject Schwann's theory of cell formation. He had, as Rather has pointed out, transferred the locus of life and disease to the cell.[312] Virchow had, in his *Cellular Pathology*, surveyed both normal and abnormal histology, in the context of his new theory of cell genesis, *omnis cellula e cellula* and of his tenet that disease processes were ultimately cellular processes[313]. Interest had been moved from the organ to the tissue and then to the cell.

In the same year that the English edition of Virchow's text was published, an independent English translation of Kölliker's *Manual of Human Microscopic Anatomy*[314] appeared. That which had been translated by Huxley and Busk for the Sydenham Society in 1853 was printed exclusively for members of that society, and the work had not, it was claimed, obtained any large circulation in the medical world.[315] The new translation by George

Buchanan was made under the superintendence of Kölliker himself and contained "all the advances and discoveries which the rapidly-progressing science of histology has made known up to the present moment"[316] The review in *The Lancet* stated that it must be "our standard authority on Human Microscopic Anatomy". Kölliker had, said the reviewer, "materially modified his opinion as to the occurrence of free cell formation, considering it to be more and more doubtful the further the investigation was prosecuted"[317]. A review in the *Medical Times and Gazette* said that although the aim of the manual was to meet the requirements of students and practitioners it was not sufficiently elementary for that purpose and that "it is behind in value to the histology of Dr Sharpey contained in the Anatomy of Quain and Sharpey"[318]. For teachers preparing to deliver lectures on histology, though, this text must have been very valuable indeed.

Two texts on histology, by Peaslee[319] and by Morel[320], were produced in America at this time. That by Peaslee "the first work on histology or the minute anatomy of the tissues, which has issued from the American press" was damned with faint praise "amply illustrated with excellent woodcuts, well known to those familiar with the writings of those men in Germany, France, and Britain who have done the most for this department of science"[321]. Morel's German text had been translated by van Buren, professor of anatomy in New York, and, its reviewer said "is really little more than an extended description of the beautiful plates"[322].

A very different reception was accorded to the translation of Stricker's *Manual of Human and Comparative Anatomy* in 1870[323]. Henry Power, then an examiner in physiology at the University of London, was said

> to have done excellent service to English histology by rendering the present work into English . . . it merits the attention of all who have even the slightest interest in microscopic anatomy . . . the book should be in the hands of every student of histology.[324]

The Lancet considered it to be a very valuable and welcome addition to English medical literature since

> modern medical literature of the higher class so teems with histological references that a treatise in which they are explained has become almost a necessity.[325]

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Figs. 120 and 121. Sections of an injected liver from the Rabbit. The slender biliary ducts arranged in the form of a plexus are divided longitudinally, the much wider blood capillaries transversely. The biliary ducts are also seen in section as dark points in the line representing the plane of contact (septum) between two adjoining hepatic cells. In the interior of each of the hepatic cells are one or two nuclei.

Figure 8.
S Stricker (Ed) - *Manual of human and comparative histology.*
London: New Sydenham Society, 1872.
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The translator acknowledged the value of the treatise of Kölliker, in its two translations, that of Quain and Sharpey, and that of Todd and Bowman, all of which he said were extremely good. But neither these, he said, nor yet Carpenter's text and the various papers of Beale, constituted a complete exposition of histological knowledge.[326] Stricker's manual was introduced by a comprehensive section on "General Methods of Investigation". Stricker himself contributed the chapter on "The General Character of Cells", and others were written by experts in their particular field. The chapter on liver, [which appeared in volume two of the text][327], was written by Ewald Hering, professor of physiology in the Josefs-Akademie in Vienna. In this he described his own observations on the arrangement of the biliary ducts and included figures which, for the first time, demonstrated a complete network of intralobular capillary bile ducts[328] [see fig. 8]. Hering's account of liver histology was beginning to resemble the details accepted today.

Stricker's entry on methods of investigation could not, however, replace the texts on microscopical technique by Beale. For teachers of practical courses, be they simply demonstrations or those offering first hand experience to the student, Beale's texts would have provided splendid detail.

Quekett's second and third editions of his *Practical treatise on the use of the Microscope* had been published some time before, in 1852 and 1855[329]. At the time of its publication Quekett's second edition was said to be "by far the most complete and practical" on its subject[330]. The third edition included a description of the "Author's microscope for Class Demonstration", which could be mounted on a carriage and sent from one observer to another[331]. An engraving showing the histological theatre at the Royal College of Surgeons, with two semi circular tramways each with a microscope mounted on its carriage was included as the frontispiece of the text [see fig. 9]. Quekett employed, he said, eight microscopes, and in the course of a lecture of an hour's duration, he could exhibit from twelve to sixteen preparations to fifty people. Quekett's intention of supplying all the details of this equipment as an appendix to the book, and of writing a separate book on practical histological techniques, was never realised, possibly due to his early death in

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Figure 9.
J Quekett - *A practical treatise on the use of the microscope, including the different methods of preparing and examining animal, vegetable, and mineral structures.*
London: Bailliere, 3ed, 1855.
Frontispiece.

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1861.

A further book, referred to by Gray, which gave details of an actual course in practical histology was that by Harley and Brown, which was published in 1868. *Histological Demonstrations for the use of the Medical and Veterinary Profession*[332] was suggested by Brown, a student, to his teacher, Harley at University College:

> the observation of the facility with which objects were prepared for examination in the presence of the class, and the readiness with which the directions of the demonstrator were comprehended and carried into effect by the student . . . the possibility of describing in an intelligible manner the method of instruction which was so successful in practice.[333]

The volume was considered by the *Quarterly Journal of Microscopical Science* as one which would provide the student with a "thorough introduction to both physiological and morbid histology".[334]

For those who needed a detailed treatise on a particular organ, rather than an introduction, a whole range of texts and articles was published during the 1850s and 1860s. On the liver, apart from that of Beale, the work of Frerichs and of Schmidt was significant.

Schmidt, in his very detailed article on the minute structure of the hepatic lobules[335] published in the United States in 1859, reviewed the current work on the subject, including that of Handfield Jones, Beale and Kölliker. He went on to demonstrate the existence in the hepatic lobule of two networks of capillaries, one of which carried blood, and the other, which he termed "biliary tubules" which carried away the excretory products.[336]

Frerichs, in his clinical treatise on diseases of the liver[337], published a year later pointed out that

> several pathological processes have been rendered more intelligible, since they have been referred back to their physiological origin and since their fundamental structural lesions have been carefully and thoroughly examined.[338]

There existed, then, a number of good general textbooks and monographs on physiology, pathology, and on histology, both normal and abnormal. With only a few remarkable exceptions, such as Beale, and to a lesser extent Sharpey, very few of the London teachers of histology did any related research of their own, and quite naturally would have relied on the popular texts of the day for the preparation of lectures. Much of the practical work on histology would have been by demonstration, enabling some students to observe tissues freshly prepared and perhaps stained with carmine.

It is not surprising, therefore, that Huxley, who had been for many years an examiner at the University of London, in his address on medical education at University College in 1870[339], said

> what has struck me, then, in this long experience of the men best instructed in physiology from the medical schools of London is . . . the singular unreality of their knowledge of physiology . . . the knowledge I looked for was a real, precise, thorough, and practical knowledge of fundamentals . . . in a very large number of cases physiology has been taught as if it were a mere matter of books, and of hearsay . . . in the minds of a great many gentlemen it has been supplanted by histology . . . I believe it will take me two years at least of absolute rest from the business of examining to hear either of the words "cell", "germinal matter", or "carmine", without a sort of inward shudder . . . it is made infinitely worse by our practical arrangements . . . the effect of such teaching comes out obviously - the unreality, the bookishness of the knowledge of the taught[340].

The consequences of medical reform

The increasing interest in the use of the microscope, as an important tool for the understanding and interpretation of both normal and pathological anatomy and physiology, took place against a background of reform of entry to the medical profession as a whole. The decades of agitation for such reform which preceded the Medical Act of 1858 have been described in detail by Newman[341] and others. Poynter[342] has pointed out that the Act was framed, not for the benefit of the profession, but to protect the populace by producing safe general practitioners. Butler[343] has explored the various attempts at medical reform and has analysed why and how legislation was finally passed in 1858. These sources acknowledge the role of John Simon [1816-1904][344] in the establishment of a register of all licensed practitioners, supervised by a General Council, whose role it was to define the qualifications needed for registration.

It was not, however, the role of the General Council to devise an ideal scheme of medical education. The 1858 Act gave the Council powers only to inspect examinations and to offer advice on the curriculum. The Council was composed of representatives of all the licensing bodies, together with Crown appointees. The usual practice in offering advice was for the Education committee of the Council to send preliminary recommendations to all authorities, whose replies would then be discussed prior to a report being made to the full Council. The licensing bodies had in fact no option but to incorporate suggestions made by the Council, or risk censure by the Privy Council.

In 1867 a committee on medical education and examination of the General Council was appointed to consider the question "what are the subjects without a knowledge of which no candidate should be allowed to obtain a qualification entitling him to be registered?". Its report, which listed ten subjects, of which the first three were Anatomy, General Anatomy, and Physiology, was adopted by the Council on June 7th, 1867[345]. Interestingly, amongst the eminent men then present were William Sharpey, as a Crown representative, and Allen Thomson, who represented the universities of Glasgow and St Andrew's.

A year later, in June 1868, another committee was established

> to consider and report how the various subjects of Medical Education which have been deemed requisite by the Council may be taught with most advantage; in what order they should be studied; and how the Examinations should be arranged.[346]

This committee, which included Syme, Acland, Thomson, Sharpey, Christison, and Parkes, "put in train a series of arrangements by which they hope to be able to obtain valuable evidence from the principal teachers and examiners in the kingdom"[347]. They requested comments from all the medical schools and examining bodies and after considering all the evidence they produced a scheme which "seems to us to arrange the subjects in a satisfactory manner, with a length proportionate to their importance . . . "[348]. Their plan, which encompassed four years of study, distinguished between preparatory and practical subjects, and advocated the teaching of "General Anatomy, including the practical study of Minute Anatomy and Histiology" in the first summer session.[349] They further recommended that "In arranging this order it will be seen that . . . Physiological Chemistry and General and Minute Anatomy should precede advanced Physiology, to which these subjects are necessarily an introduction"[350].

The interim report acknowledged that some apprehension had been expressed lest the Council might lay down rules as to methods of teaching, "which might too much limit the freedom of teachers"[351]. They appended the opinions of a large number of teachers with the comment that it would be "the wisest course to allow these opinions gradually to produce their effect on the method of teaching"[352]. They did however set out certain general rules which, they recommended, should be enforced. Among these was that

> **Minute (including microscopic) Anatomy is, in some parts of the kingdom, considered to belong to the Anatomical Course, while in other places it is included in the Physiological. We believe this latter view to be correct, and we would advise that the Anatomical lecturer shall not include in his course General and Minute Anatomy; but we also consider these subjects should be separated from the advanced Physiological lectures, and be studied previously, under the supervision of the physiological teacher.[353]**

This recommendation was the first clear invitation to the schools to include, as a separate and specific subject, but under the supervision of the department of physiology, General Anatomy. It is interesting to note that it was felt necessary to spell out that minute anatomy included microscopical anatomy. It was not clear what difference was seen between "general anatomy", "minute anatomy" and "histology", but the committee covered all interpretations by stating in its recommendations that general anatomy included the practical study of minute anatomy and histology.

The committee had further subdivided the ten subjects to fourteen which it deemed necessary for the purposes of teaching[354]. In its interim report, seven subjects from this list: general anatomy, together with anatomy, physiology, physics, chemistry, medical chemistry, and pharmacy, were to have been studied "previously to passing the first professional examination"[355]. It was at this stage then, that histology was defined as a preliminary subject, a knowledge of which was deemed necessary before further study was undertaken.

The observations of The Royal College of Surgeons were appended to the minutes of the meeting of the General Council of February 24th 1870, having arrived too late to be included in their proper place as an appendix to the report given at the previous meeting.[356] The Royal College of Surgeons report, dated 13 January 1870, included the view that

> The elementary sciences and subjects ought to be learnt, not only from lectures and books, but practically, in the sense that learners themselves shall, individually be engaged in the necessary experiments, manipulations, etc., under the direction of a teacher. And we advise that regulations of the Council to that effect shall include, besides Anatomy, already provided for,
>
> Chemistry in its application to Medicine
> Pharmacy
> General Anatomy and Physiology
> Surgery.
>
> The practical instruction in General Anatomy and Physiology, would bear to the Lectures on those subjects the relation which the business of the dissecting room does to the Lectures on Anatomy, or more nearly, perhaps, the relation which practical Chemistry bears to Chemical lectures.[357]

The Council of the Royal College of Surgeons had, at its quarterly meeting of 13th January 1870, made a further recommendation as a means of effecting this view:

> In General Anatomy and Physiology attendance on two courses of lectures is prescribed in the Regulations for the Membership of the College . . . we suggest that while one course shall remain as both courses are now, a series of didactic lectures with illustrations, there shall be substituted for the second course . . . the practical teaching previously averred to. The order of sequence between the course of lectures and the practical teaching might vary without disadvantage; and in all cases the order may well be left to the discretion or convenience of the teacher and the learner.[358]

The Council also resolved that its Court of Examiners should report on alterations necessary to the regulations consequent upon the adoption of the report.

On 12th May, at an ordinary meeting of the Council of the Royal College of Surgeons, the following alterations to the Regulations[359] were discussed and approved for the Diploma of Membership, at Paragraph III, Section II:

> III. Candidates will be required to produce the following certificates . . .
>
> 5) Of having attended lectures on General Anatomy and Physiology during one winter session.
>
> 6) Of having attended a Practical Course of General Anatomy and Physiology during another winter or summer session, consisting of not less than thirty meetings of the class.
>
> Note A. By the Practical Course referred to in Clause 6, it is meant that the learners shall individually be engaged in the necessary experiments, manipulations, etc..

It was resolved that these new regulations were to apply to candidates

"commencing their professional education on or after 1st October 1870."
The Court of Examiners which made these recommendations included Skey, Partridge, Hilton, Richard Quain, Lane and Busk, and it is significant that it was from these representatives of the profession, that proposals for changes in the teaching of histology, amongst other subjects, first came. Newman has pointed out that if there had been no Medical Act of 1858, the steady stream of improvement would have continued. Medicine, he said, had been reforming itself before the Act and continued to do so after it. The Act did not impede the improvement, but equally it did not cause it.[360]

The new regulations, however, although the recommendation of the profession, were not met with immediate and universal acceptance. The changes and improvements in teaching, in accommodation, in texts and in equipment, needed in order to conform to the new requirements, took place gradually over the next two decades. These changes, explored in the following chapter, also reflect developments in the understanding of histology, of microtechnique, and the adoption of an examination system which ensured that everyone entering the medical profession had, as a prerequisite, an understanding, both theoretical and practical, of histology and of its importance in medicine.

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CHAPTER FOUR.
HISTOLOGY ESTABLISHED: 1870 - 1886.

The response of the London medical schools to the new regulations for the Diploma of Membership of the Royal College of Surgeons was naturally varied. Most of the schools were able to respond immediately to the requirement to deliver a single lecture course in general anatomy and physiology, but few were in a position to teach a full practical class, particularly one in which the students themselves would carry out the manipulations.

This chapter explores the changes that took place in the teaching of histology in the schools as they sought to meet the regulation. These changes are viewed against a background of changing attitudes to experimental physiology, and, in Britain, a strong anti-vivisection movement.

The period 1870 - 1886 saw too the publication of a number of textbooks to promote and support the new practical courses, and the development of student microscopes for individual practical work.

The establishment of histology was confirmed when the Royal College of Physicians and the Royal College of Surgeons, having agreed to award a conjoint diploma to students beginning their medical studies on and after October 1st 1884, prescribed the subject for examination at the end of both first and second years of study. The Royal Colleges were known for this purpose as the "Examining Board in England", whose qualifying examination was enshrined in law in The Medical Act,1886.

The editor of *The Lancet* obviously appreciated the significance of the 1870 regulation when, as early as October of that year, the arrangements at University College were described, as an example of a practical course which had been offered for some years and which met the new requirements. The article[1] described the room which had been set up with a long table, adapted for the microscopes of the class, and explained that it was the intention that "each student should prepare for himself, *seriatim*, the several structures of the body, and submit them to microscopic examination, showing by his own sketches, made at the time, that he clearly apprehends the subject in hand."[2] It went on to describe the various aspects of practical physiology which were taught, including experiments on living tissues. From the description it was clear to readers that both practical histology and practical physiology were encompassed in the course, and it was concluded that it would be more or less imitated at all the medical schools. Credit was given to the Royal College of Surgeons for having required this course in the ordinary curriculum and it was hoped that the system of teaching would render impossible such comments as Professor Huxley's "singular unreality of knowledge of physiology" evinced by even the best - instructed students.

Not everyone shared these sentiments, however. Letters to the editor of *The Lancet* carried complaints that courses such as this led to the practice of vivisection, and, in addition, to the overload of the curriculum.[3] Pavy, writing as a teacher of physiology, remarked that what had been hitherto voluntarily undertaken by a few, would, in future, be compulsorily carried out by all. He did not think that the College of Surgeons intended that students would carry out physiological experiments for themselves, but should see them performed. He felt, though, that the microscopic examination of the fluids and textures formed practical work upon which "the time of the student can with much advantage be bestowed"[4].

The Medical Teachers' Association, a group which met to discuss common professional concerns and which had amongst its members teachers from the majority of the London schools, had, with John Simon and William Jenner as successive presidents, contributed to the discussion[5] which culminated in the General Medical Council's recommendations. When, in January 1871, Campbell De Morgan took its chair, he commented[6] that the College of Surgeons' novel regulations were somewhat vague, "perhaps intentionally so", and must therefore be interpreted by the teachers. Most of the schools, he said, were in advance of the former regulations and "had voluntarily adopted modes of teaching which the new regulations only now render compulsory . . . the new rules will not find us unprepared". He went on to raise questions, which he felt could best be answered at a combined meeting of the schools . . .

> **What is meant by practical physiology? . . to what extent should it embrace experimentation on animals? . . does practical physiology really mean only the practical study of subjects auxiliary to physiology, as histology, chemistry and physics?**

The latter, he felt, seemed to be the interpretation of the Council of the College, but doubtless many schools would take the wider view. He felt that the Association should congratulate itself on the establishment of the new regulations by the College.

It is interesting that De Morgan saw histology as a subject auxiliary to physiology, rather than as a subject in its own right, just as Todd and Bowman has chosen to call it physiological anatomy. The University of London too, had, up to that time, confined its practical physiology examination for first MB, to histology, and simply required candidates to examine prepared microscopical specimens. Undoubtedly a degree of expediency had determined this interpretation, but in October 1870, it was suggested that the University too should make changes to its examination in physiology, to encompass what De Morgan called "the wider view".

The University examiners in physiology, Henry Power and Michael Foster, had written[7] to the Registrar, Carpenter, concerning "the unwritten portion of the First M.B. Physiology, Pass Examination." They felt that the examination, which at that time consisted of a *viva voce* questioning of the candidates, used simply "to clear up uncertainties and obscurities of expression in the written papers", and the "showing of specimens under the microscope with the view of testing their knowledge of actual objects" should be modified. They suggested the abolition of the *viva voce* and changes to the microscopical part of the examination. Their reason for altering the latter part was twofold: first, that the system was open to abuse, with the earlier candidates telling those going later which specimens were being shown; and second, that the bare recognition of a small number of prepared slides was not the fairest test of a knowledge of histology. The former problem could be overcome, it was suggested, by having a larger number of specimens, although it would be difficult to provide a large number of fresh preparations on the morning of the examination. To remedy the second deficiency would, they said require a different method of examining:

> Let the whole day . . . be given up to Practical Histology, and let the Students be examined (say) in batches of twenty four. The batch being placed in a suitable room, there would be allotted to each Student a microscope, glasses, reagents, needles, scissors, razor, &c &c. Before each student should be placed a few (four or five) characteristic mounted specimens, and as many portions of tissue, fresh or prepared for examination, all numbered and carefully selected. Each Student would then have the whole three hours in which to examine without hurry, and to report upon, the tissues and specimens thus presented to him. The Examiners might also request the Candidates to put up preparations illustrating this or that tissue or organ.

Power and Foster suggested that several rooms might be available in the university for the purpose. There would, they said, be a rather large initial outlay for the purchase of microscopes.

One advantage of this plan, they suggested, was that it left an opening for the gradual introduction of practical physiology. Each student, they said, could be taken aside for fifteen minutes and be put through a number of simple physiological exercises, such as simple stimulation of nerve and muscle, physiological chemistry, &c. The histological part of their proposal could easily be introduced, they felt, as an examination of this kind had been carried on "by one of us at University College for some sessions back, without trouble and with good results".

In drawing their proposals to the attention of the Senate of the University, they stressed the importance of physiology to medical education . . . "the importance of such Physiology and Histology as is demanded being made real and practical, and not mere bookwork, cannot be overstated . . . of the unreality of the present physiological studies . . . we have annually recurring evidence." The evidence of Huxley's influence is clear, some of his words spoken at University College earlier that year[8] being quoted in support of the examiners' proposals.

The Senate resolved to keep the *viva voce*, and recommended that it should not be limited to the subjects of the written papers[9]. They agreed that changes were desirable for the practical portion of the examination but deemed it "expedient" to limit it to histology[10]. They resolved that the University Calendar for 1870 should be amended to read "Physiology, by *viva* *voce* and Practical Examination in Histology"[11], and that the medical schools should be notified that "at the First MB Examination of 1872 and subsequent years, Candidates will be required to pass a Practical Examination in Histology"[12].

It took another seven years for similar changes to be made to the written papers, when, on the advice of the examiners in physiology, comparative anatomy was omitted from the First MB examination, and the words "Histology and Physiology" substituted in the regulations for "General Anatomy and Physiology"[13]. It took even longer for the University to buy the necessary microscopes. It was not until 1881 that the examiners pointed out that it was "absolutely necessary" to increase the stock of microscopes. The deficiencies had hitherto been met by borrowing about twenty additional microscopes from University College, through the intervention of one of the examiners, and this arrangement could, they said, no longer be depended upon.[14]

The editors of the *Medical Times and Gazette* had reported the changes made by the University 1870 in the weekly news column of 11th February 1871. They welcomed the decision of the Senate, remarking that the candidates would not only have to familiarise themselves with the whole range of tissue anatomy, but would have to acquire themselves a certain amount of manipulative skill, "which cannot fail to be of use to them in their after-study of pathology"[15]. The editors reported that the question whether it was desirable that the practical examinations in physiology should be carried further had been left open, but they felt that provided that the students were not required to take part in vivisection . . . "we can see no reason why these examinations should be limited to histology."[16]

There is a considerable literature on the anti-vivisection movement in Britain. In particular the influence of the antivivisection sentiment on medical science has been explored in detail by French[17], who pointed out that

> it was certain of the leading members of the London medical elite who were promoting experimental medicine during the seventies and eighties . . . whose political experience and connections were vital to its survival in the face of antivivisectionist pressure[18].

These clinicians, he said, saw experimental physiology, pharmacology, and pathology as the most rapid route to a new, more powerful array of therapeutic tools.

Geison[19] has suggested that the agitation for and passage of the Vivisection Act 1876 may have done British experimental physiology more good than harm. It did not eliminate vivisection experiments, but officially licensed qualified experimentalists. He showed that by 1882 the act was being administered in such a way as virtually to guarantee certificates to qualified physiologists.

Sharpey-Schafer[20] has recorded how antivivisection agitation was a prime cause of the formation of the Physiological Society in 1876, and that current and former London teachers were prominent among its original members.

The 1870 regulations of the Royal College of Surgeons had had the initial effect of focusing antivivisection sentiment on the medical schools. In spite of this, some of them appointed men with physiological skills to introduce some experimental work into their curriculum. Others preferred to concentrate on practical histology as an aspect of physiology. Either way histology and practical histology was promoted for all intending medical practitioners, who thus became familiar with the use of the microscope and associated techniques.

Practical physiology teaching in 1871-2

At the end of the 1871-2 medical session, the *Medical Times and Gazette* reported on the "Teaching of Practical Physiology in the London schools"[21]. It asked the question "What is practical physiology and how is it taught and learned?" It sought to provide an answer by giving a detailed account of how the subject was being approached in each of the London schools. Each account was given in a very positive manner, the only clue to the real difficulties being experienced in some of the schools being the lack of detail and the brevity of the account relating to them. The description in the medical press does, though, give a good indication of the facilities, teachers, and equipment, and the proportion of time and space being given to the histological part of the course.

At University College[22], the post of Professor of Practical Physiology and Histology, in addition to that of Professor of Anatomy and Physiology, was reported, as was the College's "most abundant" accommodation, consisting of a large laboratory for the students and a private one for the professor. The internal arrangements of the students' laboratory, and the lighting were not perfectly satisfactory, but, it was reported, there was a proposal either to alter it considerably or remove it altogether to another building. The class of practical physiology was held during the winter session, when, once a week, Professor Sanderson gave a lecture, with demonstrations, on the subjects that were to be studied practically by the students on the following days. The first half of the session was devoted to histology, while the remaining months were devoted to physiological chemistry and other experimental work. The report went on

> At the commencement of the course on histology each student has assigned to him a place at a table, where he finds himself provided with a microscope, the other necessary apparatus, and a rack of ordinary histological reagents, such as a solution of salt, acetic acid, alcohol etc., and the various materials for colouring and mounting. The microscopes used are mainly by Crouch, but several new German ones are also available. Fresh tissues chiefly are given for examination, and the phenomena of life, as far as demonstrable microscopically, are specially studied; the students thereafter learn to preserve, harden, and colour specimens, to cut sections, and to mount permanent objects.

The number of microscopes at University College was thought to be unusually large, but this was not the case at King's College, nor did the accommodation match that at University College. At King's[23], it was reported, Professor Rutherford taught both the theoretical and the practical aspects of physiology and histology, assisted by a demonstrator. His lectures were abundantly illustrated by microscopic and experimental demonstrations. In addition to the lectures, special demonstrations of microscopical specimens were frequently given to illustrate the histological points. Practical histology, it was reported, was the work of the summer session, with meetings three times each week. There was no specialist accommodation at King's, and the dissecting room was temporarily fitted up with tables and seats, a situation which, it was said, would be relieved by the proposed building of a new laboratory. The report went on

> Each student on commencing his histological work is provided with material and the necessary reagents arranged before him in a neat rack. He brings his own instruments with him, including, if possible, a microscope; but should the microscope be furnished by the College, a charge of one guinea is made for its use during the session. From the simple tissues the students pass on to examine the various organs, making and mounting their own specimens, including sections; but as the latter are usually not worth preservation, each student is presented with a good specimen of the same object previously prepared in the laboratory. This he mounts and keeps. The work is daily prefaced by a few remarks from the Professor on the tissue to be examined, and these may be more extended if the subject is a difficult one.

A less satisfactory arrangement was to be found at Charing Cross Hospital[24]. There, the practical physiology was taught partly by class demonstration and partly by practical instruction to the individual students. The class demonstrations were given once each week in the winter session, by Dr Silver, and were intended to illustrate the subject being discussed in the theoretical lectures. Whereas some of the demonstrations were of experimental physiology and physiological chemistry, the practical instruction given by the demonstrator, Dr Bruce, was almost exclusively in histology:-

> The students meet in groups of eight or more in the physiological laboratory, which is just sufficiently large to allow this number to work in pairs at tables facing the windows. To each pair of students a microscope is allotted .. the tissues and organs are examined in due order - fresh, and if possible living specimens being provided as frequently as is practicable. It has been found by experience that there is not sufficient time to teach satisfactorily the methods of permanent mounting. The microscopes are provided by the school, and are partly Hartnack's and partly English. The students provide their own instruments for mounting.

There was no special accommodation for the practical histology class at St Bartholomew's Hospital[25], where students had to make do with a reading room, temporarily provided with tables, which lacked preparation and storage space and which was poorly lit. There they studied practical histology in the summer months, following the lectures on the tissues given during the previous winter. The practical classes were conducted by the demonstrator, Mr Symons, who "directed the students' attention to large cards" listing the features of the specimens. The report went on:-

> The students, numbering on average about seventy, meet once a week for an hour and a half, some twenty or more at once, the class being held three times a week . . . the animal tissues are gone through in order, beginning with the blood, the connective tissues,etc., always mounted by the student himself; thereafter the organs are similarly

examined, and the art of cutting sections, staining and permanent mounting acquired. The microscopes used are all English, by Beck or by Crouch, and fitted with two powers, a high and a low. From those students who do not bring their own microscopes with them a fee is charged for their use; the result of this rule is that two-thirds of their number are now in possession of instruments of their own, and we believe the £5 microscope of Pillischer is a great favourite with them.

The accommodation at St George's Hospital[26] was worse than that at St Bartholomew's. At St George's there was not even an attempt to provide a room for the purpose. In the museum at one end of the gallery a table was placed against the railing, leaving sufficient room for nine seats on which the students worked. In such circumstances there was no preparation or storage space and the lighting was very poor. Proposals were said to be on foot either for building a new laboratory or for converting a room in the neighbourhood of the school. Despite this, histology was taught by the demonstrator, Dr Cavafy, in the winter session:-

The students attend for an hour to an hour and a half three times a week, each man receiving instruction for an hour to an hour and a half a week. Here the pupils are trained by frequent practice to acquire a perfect familiarity with the microscope and with microscopic appearances, and at the same time to investigate for themselves the minute anatomy of the animal tissues and organs.

The students were reminded by the demonstrator of the description they had already heard in the systematic lectures, and directed to the significant characters "on which to fix their eyes". Despite the lack of a proper laboratory, the application of "more recent and improved methods" of preparing and examining objects, was observed at St George's.

The arrangement of the courses at the Middlesex Hospital[27] was such that the theoretical lectures were illustrated and completed by the practical sessions, both of which were given by the lecturer on physiology. The theoretical lectures, ten of which were on histology, were given in the winter, while the purely practical sessions, beginning with histology, were given in the summer. The practical classes in histology were given in the chemistry laboratory, where the light was said to be suitable for microscopic work. The microscopes were English and good, but there were not enough for students to have one each. Nevertheless

after five weeks have been spent over the simple tissues, portions of liver, kidney, lung etc., are supplied to the students who cut, colour, and mount sections, although

> not for permanent preservation. At short intervals, also, after the completion of their practical histological course, the students are taken over a number of permanently mounted specimens to test and improve their powers of recognition.

The situation was much better at Guy's Hospital[28]. There the room in which practical histology was taught was said to be large and commodious, fully furnished with tables, etc., had good storage space and was well lit by roof lights and end windows. The theoretical lectures were given by Dr Pavy in the winter session, when individual instruction was also given in practical histology by Mr Pye-Smith.

> The class assembles three times a week for one and a half to two hours ... At the first two meetings of the week the regular course of histology is pursued; on the third day an extra hour is devoted to permanent mounting, The assistant demonstrators instructing the students in the arts of cutting sections, colouring, and so on . . .

At Guy's, each student had to supply his own microscope, with two objectives of a quarter of an inch and one inch.

At the London Hospital[29] there were, in contrast, "abundant" microscopes. These were English, by Crouch, Baker, and Powell & Leyland. They were provided with 1-inch, 1/4-inch, 1/6-inch and a few 1/8-inch objectives. Students were charged 10s a session to use them and were at the same time encouraged to buy their own instruments. The London did not follow the practice of the other schools in separating the theoretical from the practical course, there "the two courses are most intimately combined so as to be mutually dependent and illustrative". The course met in the winter months:-

> Twice a week lectures are delivered in the theatre by Dr Fenwick and Dr Woodman; these lectures are made as practical as possible by the class demonstrations of microscopical and chemical facts. On the third day the students assemble in the physiological laboratory, where they are taught to repeat practically for themselves, what they have learned immediately before . . . at first it is chiefly histological, as the microscopical anatomy of the tissues is lectured upon at an early part of the course . . . on the fourth day the demonstrator . . perfects their training in manipulating and specimen mounting.

The London was said to be the only school to provide gas lamps to illuminate objects under the microscope. The lamps stood between a pair of students, who faced each other at long fixed tables. Each worker also had a drawer to hold small instruments, while reagent stands were placed on the tables. As a rule, fresh tissues were used for studying animal histology, but the school also had a stock of injected and hardened preparations.

The Westminster Hospital[30], however, had no physiology laboratory, the students having to work in the lecture theatre, to which apparatus and reagents were carried from the chemistry laboratory. In this unsatisfactory environment a course of thirty lectures was delivered. Included in the subject was instruction in the use of the microscope and in the preparation of tissues for microscopical examination. Individual students were required to make sections and mount specimens. The report, perhaps significantly, made no mention of the number of microscopes available to the students.

Apparently hitherto unreported, this account of the details of the teaching of histology in the London schools in 1871-2 demonstrates the heightened interest in the teaching of practical histology which was then beginning to obtain. It is also, of course, invaluable for the purposes of this present thesis as it establishes a baseline from which to trace developments in the schools during the next decade.

Progress at University College

At University College, Burdon Sanderson had lost no time following his appointment in requesting better facilities and equipment[31], since, he said

> the examining boards have made it necessary for every student to go through a course of practical exercises relating to the intimate structure and function of the organs of the body . . .

He pointed out that the space currently available enabled him only to demonstrate, rather than allow each student to carry out operations for himself. He requested additional space, lit through large windows, and also, as "absolutely essential" additional apparatus costing £82, of which £20 was for microscopes.

Equipment was provided but, at the completion of his first practical course, he again requested more space. In his letter to the College Council[32] he wrote

> Having just brought to a close the course of practical instruction in physiology and histology - the first course which has been given in this college since this kind of teaching was made a necessary part of professional medical education - I am anxious to bring under the notice of the Council the difficulties I have experienced during the

> first session in consequence of insufficiency of space . . . it is obvious that in a system of teaching of which it is the fundamental principle that the student shall himself perform the exercises which were formerly done for him by his teacher, or merely described in a lecture, it is desirable, if not necessary, that each student should have his own place of working - his own stool and table, where he may pursue his studies with as much continuity as is consistent with his other occupations.

He gave reasons why more than one room was necessary, and proposed that the vaults under the physiology laboratory should be used for chemical operations, "devoting the present laboratory to the microscope and other instruments liable to injury . . . " Sharpey supported Burdon Sanderson's request - "I feel assured that both the reputation and the material interests of the College would be greatly promoted thereby"[33].

The Committee of Management were, however, of the opinion that the requirements of the class of practical physiology would be met more satisfactorily by erecting a new building in the south east court than by the conversion of the vaults.[34] Sharpey, Burdon Sanderson and Professor Lewis, the Professor of Architecture, were requested to attend the next meeting of the Council, at which, on 16th July, 1872, the members of the Council and the professors visited various localities proposed for the additional accommodation.[35] At their meeting on 3rd August the Council were recommended to adopt the plan for erecting a new building in the north cloister, at the estimated cost of £220.[36]

The college was thus certainly willing to promote work on physiology, but an enormous impetus for its teaching came from outside, rather than internally. On 1st November, 1873, a letter was read to the Council[37] from Mr T J Phillips Jodrell, in which he offered, under certain conditions, to give £7500 to the Council for the endowment of a chair of Physiology. The conditions were set out in a draft instrument[38] which was read at the Council meeting of 6th December, 1873. In it Jodrell stated that

> I am desirous of promoting the study of Human Physiology in University College, and especially of encouraging original research in combination with professional teaching . . . my intention in creating the said endowment being to . . . induce men of eminent ability who may be willing to cultivate science for its own sake to forego more lucrative sources of emolument and to devote to original research all the time that they can be spared from the lecture room . . .

He desired the combination of the two professorships, that of general anatomy and physiology and that of practical physiology and histology, into a single endowed chair. He also recognised the need for the new professor to have the assistance of one or more coadjutors, who would be nominated by him.

A committee, formed for the purpose, had further talks with Mr Jodrell, and arranged that, at the end of the 1873-4 session, the chairs would be united and that the department would be headed by the newly styled Jodrell Professor of Human Physiology[39].

This endowment meant that, for University College, the pattern of one man devoting his full time to the study and teaching of physiology, established by Sharpey in 1836, could continue. Elsewhere, so long as professors were paid by student fees and were in effect part time - having also posts at the hospital or in private practice - little research was done in the colleges. It also meant that one well paid man, with his nominated assistants, could concentrate on this work rather than it devolving to a number of different, perhaps less well motivated and less well informed practitioners.

Sharpey resigned his professorship in May 1874[40], after thirty eight years service. He was created Emeritus Professor and granted a pension of £100 per annum for life.

In June 1874 the Council decided that "Professor Sanderson is a fit and proper person to be appointed Jodrell Professor of Human Physiology" and that the advertisement for candidates could be dispensed with.[41] On 20th June Burdon Sanderson was appointed[42] and within a few days he nominated Mr Schäfer and Mr Page to be appointed coadjutors, Schäfer to be called Assistant Professor of Physiology.[43]

In the Annual Report for 1875[44] the new posts were reported together with the establishment of

> a new laboratory, designated the "Jodrell Laboratory", specially intended to afford means for prosecuting original physiological research, has been provided, and furnished with the requisite fittings, instruments, and apparatus . . .[45]

The prospectus for the 1874-5 session indicated that from that year Burdon Sanderson divided the course into two distinct parts, "of which one relates to General Anatomy, including Development, the other to Physiology"[46]. It was Schäfer who taught both the theoretical course on "the structure and properties of the textures of the human body" and the practical course on Histology. Under the heading "The Physiological Laboratory", it was proposed that

> Special Courses of instruction in the use of the Microscope and in the methods of histological work, will be given during the Lent and Summer Terms by the Assistant Professor of Physiology.[47]

Edward Schäfer [1850-1935], whose father had German origins, was born in London. All his medical education had been received at University College, where he was a pupil of William Sharpey. In 1872 he became the first Sharpey Scholar. Michael Foster had tried to take Schäfer with him when he went to Cambridge, but Schäfer remained in London to work with Burdon Sanderson. He was elected FRS in 1878, and was knighted in 1913. His obiturist[48] explained that Schäfer owed much to Sharpey and in 1918 added Sharpey's name to his own, his son, who had already been named Sharpey - Schafer, having just been killed in the war.

In June 1876 Burdon Sanderson asked the Council to confer on Schäfer the title of "Professor of Histology". The Council would not comply, however, feeling that this did not meet the terms of the Jodrell endowment.[49] A year later, in May 1877, it was proposed that Schäfer be styled "Professor of Physiological Anatomy"[50], a title which the Senate[51] felt would not interfere with Schäfer's position with regard to the Jodrell endowment. This too was turned down by the Council, and Schäfer continued to be called Assistant Professor of Physiology. In view of the history of the teaching of general anatomy and physiology at University College, it was hardly surprising that the Council were unwilling to see two professors working together in this area of the curriculum, and preferred to keep a clear distinction between the Jodrell professor and his coadjutors.

In 1878 Schäfer himself wrote to the Council[52] in pursuit of an independent chair for himself and for histology. He pointed out that the histology and embryology lectures which he delivered, comprised two fifths of the general course in physiology, and the histological part of the practical course, originally comprised three fifths, but, in 1878, four fifths of that course. He pointed out that both in lectures and in the practical classes he had been allowed complete independence, and that histology was as distinct and well defined a subject as any taught by a professor of the College. This request also fell on deaf ears. The letter, though, provides probably the only source of information regarding the comparative proportion of histology to other aspects of physiology in the courses at University College at that time.

The course of lectures given by Schäfer during the 1878-9 session was recorded in a series of notebooks[53] by one of his students, W D Halliburton, who was later elected the Sharpey scholar. In his introduction to the course Schäfer had given a definition of histology and the reason for its inclusion in physiology

> Histology is the study of the structure of the parts of the body: it may be called minute anatomy because in most instances the use of the microscope is necessary: it aims at the study of the structure of the parts of the body as presented in the living animal and therefore is included under the general term Physiology.[54]

Schäfer identified the chief tissues as the blood, epithelial, areolar, fibrous, elastic, cartilaginous, osseous, muscular, and nervous tissue. He went on to group areolar, fibrous, elastic, cartilaginous, and osseous as connective tissues, all of which were derived from the mesoderm of the embryo. Muscle and nerve, he said, were the essential living tissues of the body, being made of living matter, while in many cases the other living tissues were not. Schäfer then proceeded to discuss each of what he termed the elementary tissues in turn, referring students to figures in *Quain's Anatomy*, before moving on to describe the structure of the various organs of the body.

Halliburton's notebooks also include his notes of Burdon Sanderson's lectures, which Halliburton termed "physiology proper". They show that no attempt was made by the two lecturers to parallel their teaching, matching a histology topic with its physiological aspects, until the sense organs were described, when the minute structure of both eye and ear were discussed immediately before the physiology of vision and hearing[55].

The practical histology notebook is a plain drawing book[56]. Drawings of over seventy preparations were included. Many of these had the number of a preparation at the side of the drawing, indicating that prepared slides were used. Others, such as blood, epithelium in saliva, and muscle had no specimen numbers and were probably prepared from fresh material. Some of the sections such as that of liver were prepared from injected material, with blood vessels having been injected red and bile ducts blue. Rather surprisingly the drawings, with the exception of that of a tooth, are not labelled. Also included in the practical notebook is a step-by-step account of the method of embedding a specimen in cocoa-butter, then of staining a section in magenta and mounting in balsam.

When in 1883 Burdon Sanderson resigned from the Jodrell professorship, having been appointed Waynflete Professor of Physiology at Oxford, Schäfer was appointed in his stead, being the only candidate for the post. Schäfer included in his submission[55] for the post the fact that he had published an histology textbook and had edited the microscopical anatomy section of *Quain's Anatomy*. His testimonials were from the foremost teachers and physiologists of his day:- Bowman, Foster, Huxley, Kölliker, Ludwig, McKendrick, Romanes, Allen Thomson, and Tyndall. Burdon Sanderson, in his testimonial said that Schäfer . . .

> . . . gave the systematic winter course on Histology. Since 1880 the instruction in Physiology and Histology has been much extended and now consists of elementary courses of lectures for first year students, all of which have been given by Mr Schäfer . . . has given every year since his appointment an extended course of practical instruction in Histology . . . the subject of Histology or Minute Anatomy . . . forms an essential part of the systematic instruction in Physiology as it has been given in this college . . . is the author of a work on Histology, which is universally used both as a book of reference and as a text book. He has also published as excellent manual of Practical Work on Histology. He is a clear and fluent lecturer, and has a large and very varied experience in practical teaching.[58]

Burdon Sanderson's remarks show not only that Schäfer was a good teacher of histology but give a further clear indication of the importance of histology in the physiology course at University College. They also reflect the changing pattern in the examination system at that time.

Following Schäfer's appointment as Jodrell Professor of Physiology he nominated Dr J A McWilliams and Dr W D Halliburton as his coadjutors, and, after some debate in the Council, both were allowed the title of assistant professor.[59]

At University College then, partly through the expertise and determination of successive professors - Sharpey, Burdon Sanderson and

Schäfer; partly as a result of the Jodrell endowment; and partly through the positive attitude of the Council to the teaching of this area of the curriculum, physiology, and histology as a significant subject within it, became very firmly established.

The struggle at King's

The published accounts of the teaching of physiology in the early 1870s at King's College, that printed in the calendars, and the notes on the course on histology taught by Rutherford, hid the struggle for accommodation and resources that marked the introduction of the teaching of practical physiology at the college.

The *Calendar* for the 1870-71 session announced that the course on physiology contained "a complete account of Human Physiology and Histology or General Anatomy . . . During the course, all the tissues of the body are demonstrated with the aid of the microscope . . ."[60]. In the following year two distinct courses were described, one headed simply "Physiology", the other "Practical Physiology". The first was a course of lectures similar to that given in the previous year, which still featured the demonstration of the tissues with the aid of a microscope. The second included practical histology, and it was stated that "in this section each Student prepares, examines, and preserves for himself specimens of nearly all the tissues of the body"[61]. Every student, it said, must provide himself with a microscope approved by the Professor of Physiology or else be charged £1 1s for the use of a college instrument.

In an editorial entitled "Practical Histology", in the issue of 13 January, 1872, the *Medical Times and Gazette* commented that

> The authorities at the College of Surgeons very properly passed a resolution enforcing attendance on a course of practical physiology on all students entering the Profession after a given date. But they refused to give any definition of what they considered a proper course of practical physiology, and so each teacher is left to his own devices . . . Practical Histology is one of the most important branches of Medical education . . . A well-thought-out scheme of study must therefore be of the greatest importance to both teachers and taught . . . Such a scheme from the well-skilled pen of Professor Rutherford appears in the present number of the *Quarterly Journal of Microscopical Science* . . . directions for a complete course of microscopical study, so far as histology is concerned; and we are bound to say that the course is neither too diffuse nor too contracted - it fairly meets the wants of the student.[62]

These excellent detailed notes by Rutherford, were he said, the system of teaching adopted by his "old master, Professor Bennett, of Edinburgh, the gentleman who first taught Practical Histology in this country"[63]. Rutherford pointed out that whereas in Edinburgh the students of his ordinary class merely examined the tissues, "I now find no difficulty in providing every pupil with the means of making for himself a little cabinet of microscopic specimens of the various tissues". Rutherford had found that "the whole of Histology may be gone through in twenty four lessons, each lasting from an hour and a half to two hours." He felt that if a good microscope was used "the labour of tuition is light", and recommended Hartnack's instrument as being thoroughly satisfactory[64]. Every detail of his course was described, including the arrangements to be made by the teacher prior to the class, the techniques of teaching it, and directions for all the necessary microtechnique. He described the examination to be carried out on each of the tissues and organs. On liver, for example, cells of fresh cat, rabbit or ox liver were to be examined in a salt solution and then magenta added; and a thin section of cat liver hardened in chromic acid or alcohol, clarified and preserved in glycerine, was to be examined, as was a series of preparations of injected liver.

In a letter to the editors in a subsequent issue of the *Quarterly Journal of Microscopical Science* Rutherford declared that he had been puzzling for eight years over the problem regarding the manner in which practical histology may be best taught to medical students, and "I am labouring under the notion that it is not possible to improve upon the method we adopt"[65]. This very positive statement is in sharp contrast to the attitude adopted by Rutherford in a series of letters urging the Council of King's College to provide more resources and better accommodation for the teaching of his practical course in physiology.

A committee had been appointed to consider what changes were necessary at King's following the changes in the curriculum by the Royal College of Surgeons. Their report[66], unanimously adopted by the Medical Board, was presented to the Council on 9th December 1870[67]. The report stated that, whereas practical physiology had been taught in some schools, such as in the University of Edinburgh and at University College, "unfortunately no arrangements have hitherto been made at King's College". It emphasised the need for a suitable laboratory, and recommended the erection of a new building on the Thames embankment, in front of the dissecting room. The committee thought it advisable to arrange the laboratory so that forty students could be taught at the same time. A list of the equipment to furnish such a laboratory was appended to the report. The report ended with a plea -

> We would desire the speedy attention of the Council to this matter as the laboratory is required during the ensuing summer session. All the other medical schools are actively engaged in making preparations for the tuition of practical physiology and unless similar preparations are speedily made by us, the Medical Department will no longer be able to comply with the requirements of the examining board.

The Council resolved that the report would receive "the fullest attention with as little delay as possible", and extracts of it were sent to the Commissioner for Works[68].

Rutherford meanwhile was urging immediate action. In a letter[69] to Cunningham, the secretary of the Council, he expressed the hope that the fact that he had taught a practical class in the chemistry laboratory during the previous winter would not encourage the Council to

> take up the idea . . . that there is not urgent need for a physiological laboratory . . . As it is I struggle on in it just to keep King's College floating, but it is scarcely possible to get on at all . . . I know not what will become of us. One thing is quite certain we <u>cannot get on without it</u>.

In the same letter Rutherford withdrew his proposal to furnish microscopes on finding that his income was only £140.

A week later in another letter[70] he sought

> to remind the Council of the extreme importance of something very definite being done immediately with regard to practical physiology . . . as it is absolutely essential for the very existence of King's College as a Medical School that a course in Practical Physiology be given this summer - we must do the best we can to cloak over our deficiencies.

He begged Council at least to allow him to order the equipment. In the same letter he recommended that Dr Ferrier be appointed his demonstrator. In response to this the Council resolved [71] "to make the necessary arrangement for commencing the class . . . in the ensuing summer" and "to appoint Dr David Ferrier to the office of demonstrator . . ."

In June of that year, 1871, Rutherford wrote in desperation to the Council "I know not what is to become of us" - since no plans were being made to construct a new laboratory. Yet again, in December 1871, Rutherford wrote -

> I have done all in my power to cover over the deficiency, but it cannot be covered over. It is impossible to teach successfully with the scanty room, miserable light, and lack of arrangements at our disposal . . . King's College Medical School will undoubtedly suffer unless something is done . . . At University College, St Thomas's Hospital and now at St George's they have already got splendid laboratories.[72]

The Council, in response, said that they it was" doing everything in its power to further the object he has in view"[73]

By the end of the summer session 1872, however, Rutherford's pleas had begun to be answered, and he was able to tell the Council that

> with the exception of one or two small instruments . . . I have now completed the purchase of instruments for the Physiological Laboratory at King's College . . . the expences incurred in the tuition of the practical class have been submitted to the Dean.

He enclosed an account for £45 13s for apparatus and for £7 15s 2½d for the expenses of the laboratory in the summer session of 1872[74].

Rutherford did not however remain for long enough to enjoy the new facilities at King's. Plans for the laboratory had been agreed for less than a year when, in October 1874, he resigned both his chair and his office of assistant physician to the hospital, following his appointment as Professor of Physiology in succession to Hughes Bennett at the University of Edinburgh. He had warned Cunningham of the possibility of his resigning earlier in the year, when in a letter about the new Laboratory at King's he had said

> I have planned all this laboratory as carefully as if I would certainly be its director, yet this is very doubtful . . . the Chair of Physiology in Edinburgh has fallen vacant. It is worth more than £1200 a year for one course of lectures, so I should in Edinburgh exceed £1200 for what I get £200 in King's College. Who could resist the temptation?[75]

It is difficult to assess the true gravity of the situation at King's during Rutherford's tenure. Richards has pointed out[76] that despite the lethargy and financial strictures of the College, Rutherford was, in fact, a gifted and devoted teacher. It is quite possible that Rutherford was making as much , if not more, progress at King's than was the case in many other medical schools in London. His standards, though, were very high and his temper short. When

Rutherford returned to Edinburgh *The Lancet* reported that he would be much missed in London.[77]

Dr David Ferrier, with the assistance of the other demonstrator Dr Urban Pritchard, agreed to undertake the duties of the chair until the election to the post was made.[78] The first advertisement failed to attract any candidate considered worthy of the chair, and so Ferrier was asked to continue the lectures until Christmas, and Dr Beale to carry them on from Christmas to Easter. Pritchard, who had been a candidate for the chair, was asked to take the practical course in the summer session, but, not surprisingly, was unwilling to do so[79]. In the circumstances the Council decided to postpone the practical course until the following winter session, and to wait some months before readvertising the post of professor of physiology[80].

The second advertisement was placed in May 1875 and included the fact that "a large new Physiology Laboratory is lately furnished and ready for use."[81] In June the appointment of Dr Gerald Yeo was recommended to the Council [82].

Dr Gerald Francis Yeo [1845-1909][83], in his letter of application[84] had outlined his experience not only in Dublin, from which University he had graduated, but in Continental schools. He had worked in Paris "at the microscope" with MM Cornil and Ranvier, in their private laboratory; in Berlin on practical histology and physiology with Virchow; and in Vienna on original scientific investigations in Stricker's laboratory. Yeo's current post was Professor of Physiology at the Carmichael School of Medicine in Dublin, where he had given "the usual Course of Lectures, and gave Courses of Practical Instruction in Histology". Yeo's referees, who included Ranvier and Virchow, commended him to the King's College, as did his membership of the Church of England.

Yeo at first combined his chair in physiology with the office of assistant surgeon to the hospital, a post which he soon relinquished in order to give his whole time to physiology. He was a man of great enthusiasm and energy and he remained at King's until his retirement in 1890. He was one of the founder members of the Physiological Society, which was formed a year after his appointment to the chair at King's, and was its first secretary, a post he relinquished only on his retirement from the College.

The other London Schools

The need for new laboratory space and extra demonstrators to assist in the teaching of practical physiology and histology was not peculiar to University College and King's College. At St Bartholomew's a sub-committee was appointed[85] at Morrant Baker's request to consider what steps should be taken to comply with the requirements of the College of Surgeons. Its report[86] recommended that one of the four lectures in physiology given each week should in future be devoted to the practical class; that a demonstrator in practical physiology should be appointed, at a salary of £52 10s per annum; that the Reading Room be used for the teaching of histology and physiological physics, and the chemistry laboratory for the teaching of physiological chemistry; and that the finance committee consider the question of what extra fees should be demanded of the students to cover the new course.

As a result of this report, one of the surgical registrars, Mr H E Symons was elected demonstrator and it was agreed that permission should be sought from the Treasurer to use "a vacant room, or rooms, in the College or elsewhere, for practical physiological work"[87].

The *Calendar* for 1870-71[88] had simply indicated, under the heading "General Anatomy and Physiology", that arrangements would be made for a course of practical physiology, in accordance with the most recent regulations of the Royal College of Surgeons. In 1871-72, the practical physiology class was announced separately as being

> **arranged as far as possible so as to enable students to learn, by individual practice and manipulation, the structure and endowments of those organs and tissues which have formed the subject of the preceding course of lectures[89]**

This latter course of lectures, given by Morrant Baker, was unchanged and he continued to include the demonstration of microscopical structures at the end of each lecture. In this session also Morrant Baker reported that at least five additional microscopes were needed for the practical class.[90]

Early in the 1872-73 session Symons wrote to Morrant Baker[91], drawing to his attention the unsuitability of the Abernethian Society's room for histological work, it being overcrowded, lacking water, and lacking suitable surfaces on which to use reagents and on which to cut sections. He suggested that "the microscopic portion of the work should be continued in the chemical laboratory, which seems to me to be more suitable in every way for this kind of observation". He added that the laboratory was seldom used during the winter session except for practical chemistry as applied to physiology, which was after all a continuation of his own course.

It seems clear that at this stage the practical work in histology was taught quite separately from the physiological chemistry and that experimental physiology featured hardly at all. In November 1872, the lecturer in materia medica, Dr T Lauder Brunton, drew the attention of the Medical Committee to "the insufficiency of space for those anxious to institute experimental physiological researches"[92]. The students themselves complained about the inconvenience caused by their being denied the use of the Reading Room[93]. The response of the medical committee was to offer, subject to its use by the lecturers, their own committee room, for practical work, and to institute another sub-committee to look into the problem of accommodation.[94]

The separation, at St Bartholomew's, of histology from the rest of physiology was made more distinct when in January 1873 Morrant Baker suggested that "it would be well to secure the services of Dr E Klein, if possible, as a lecturer in histology . . . "[95]. Baker suggested that Klein should be paid from the receipts of the physiological lectureship, which would have accrued to himself had he continued to give all the lectures. Yet another sub-committee was formed to consider this proposal. The outcome of their deliberations was that permission was sought from the Governors for Dr Klein to deliver lectures on histology (not exceeding fifteen) in the winter session of 1873-74, and that he be remunerated at the rate of five guineas per hour.[96]

Edward Emanuel Klein [1844-1925] had been educated in Vienna, where he had worked in Stricker's laboratory. In 1869 Klein had visited England to arrange for the translation of Stricker's histology manual, and had become acquainted with Burdon Sanderson, Simon and Huxley. In 1871, on the invitation of John Simon, then the Principal Medical Officer of the Local Government Board, he had come to London to carry out some investigations on infectious diseases for the Board. He worked with Burdon Sanderson, first in his private laboratory in Howland Street, and later at the Brown Institution where he was deputy director. Thus he gained an introduction to the London scientific circles[97].

Klein accepted the invitation to lecture on histology at St Bartholomew's. This was the first occasion on which a teacher was brought into a London medical school specifically to teach histology, as distinct from "the use of the microscope".

A letter from the Royal College of Surgeons requesting information from the medical school about the means it employed to carry out the College's regulations with respect to practical physiology[98], spurred on the accommodation sub-committee to advise the medical committee that the chemical laboratory should be used for "microscope classes" in the ensuing winter session. Symons was also reelected as demonstrator for a further two years.

The *Calendar* for 1873-74 announced Klein's lectures under the heading of "General Histology, or microscopic anatomy of the elementary tissues". A detailed syllabus was given, far more detailed, in fact, than that for "General Anatomy and Physiology" given by Morrant Baker, of which it formed only a part. Apart from a section on the general character of glands, all Klein's lectures were on the "elementary" tissues, which included blood, epithelium, connective tissue, cartilage, bone, muscle, blood and lymphatic vessels, and nerve, while Morrant Baker dealt with physiology and with the structure of organs.[99]

Klein's lectures were without doubt a success, since in the following year he was invited to conduct another course. In 1876 he was elected a member of the Committee of Medical Officers and Lecturers[100]. In 1879 Morrant Baker gave up six more of his lectures to Klein, five on generation and development and one on histology, and a year later five more. In 1881 Klein gave the entire course on histology and development[101]. Thornton in his

History of Physiology at St Bartholomew's commented that "once Klein had mastered the language, he became a brilliant teacher, and possessed an unrivalled knowledge of histology"[102].

The practical physiology classes, which still included practical histology, did not enjoy such continuity of teaching, although Klein's direction must have been invaluable. An assistant demonstrator was first elected from amongst the clinical staff in 1875, and from then on there was an almost annual turnover of demonstrators and assistant demonstrators[103]. The facilities for teaching physiology improved in 1879 with the building of a new block for the Medical College, which included a physiology classroom situated between the library and the museum.[104]

At the London Hospital there seems to have been little sense of urgency in their response to the new regulations of the Royal College of Surgeons. When, in June 1870, the Dean raised the subject, the Council "decided to defer the consideration of the best method of meeting them until the lecturers on those subjects had expressed their views"[105]. It was not until November of that year that the report of the lecturers was read and adopted. No record of that report remains, other than the fact that they recommended that a committee be formed to consider the whole subject of physiological teaching, and to report to the Council. Dr Fenwick and Dr Woodman were appointed as the committee.[106]

At the same time[107] the recommendations of the Library and Museum Committee's with respect to the teaching of physiology were adopted. These included the purchase of an additional six microscopes, and the proposal that "the room over the reading room be fitted up as a working microscopic room, and be fitted with three tables and benches running lengthwise and parallel to each other and to the side windows, and that gas and water be laid on as required."

The Committee on Practical Physiology reported in June 1871[108], and its recommendations were adopted. These included that twelve microscopes, with eye-pieces and object-glasses be provided, and that a half guinea fee be charged for the use of a microscope by those students who did not bring their own. The estimate for the twelve instruments, from Smith and Beck was £76.

On the surface all appears to have been satisfactorily arranged, especially in view of the fact that the Royal College of Surgeons had "recognised the three modes of carrying out the Course of Practical Physiology which had been described"[109], presumably in response to a general request. In July 1871, however, both Fenwick and Woodman resigned their joint physiology lectureship on the grounds that "important changes had been proposed in the Physiological Department by a private committee of members of the Council, without consultation with the holders of the Chair"[110]. What this proposal was is not mentioned in the minutes, but some dissatisfaction on the part of council members is indicated. It is equally clear that the council could not afford to lose the two lecturers as it was resolved to reassure Fenwick and Woodman, the council being "much obliged if they would continue in office"

The College *Calendar* for 1871-72[111] gives some indication of the course given by the two lecturers. It is difficult to see how they had satisfied the Royal College of Surgeons regulations. Under the heading "Physiology and General Anatomy - Practical Histology and the use of the microscope", it was announced that

> the course combines theoretical instruction with the Practical demonstrations required by the New Regulations of the Examining Boards. The practical part embraces, 1st, the methods of investigating and preserving the tissues and organs of the body in health and disease; and 2nd, the examination of blood, urine, sputum, fæces. A Cabinet of Microscope Preparations is open to the students.

Such a statement could well have described the kind of work going on at University College, King's, and elsewhere thirty years previously.

In November 1872 the physiology lecturers made a modest request for extra fittings, a table, gas apparatus and a cupboard.[112] The following April Fenwick resigned and Jeremiah McCarthy, an assistant surgeon to the hospital, was elected in his place. Fenwick thereafter lectured in various other subjects in the school and in 1879 was elected physician to the hospital. In 1874 Woodman resigned his share of the lectureship, going on to become full physician in 1877. In May 1874, McCarthy was elected sole lecturer on physiology.

Jeremiah McCarthy [1837-1924] remained in his physiology post until 1889, when he became lecturer in surgery, having been appointed full surgeon to the hospital. McCarthy was a founder member of the Physiological Society and a frequent attender at meetings. All his publications, however, were on surgical subjects, and it would seem, that apart from his teaching he made little contribution to physiology.[113]

It was McCarthy who, in 1878, initiated moves to bring about the enlargement of the medical school. He wrote requesting "that Council and others be summoned to consider the enlargement of the medical school . . . there being insufficient space in the chemical and histological theatres and the classrooms"[114]. Clark-Kennedy records that by 1879 further extension of the college proved necessary. The dissecting room was too small, and a new library, physiology room, and chemical laboratory were needed. These alterations would, it was estimated, cost £3000, which it was proposed to raise by subscription.[115]

At St Thomas's Hospital, in contrast to the arrangements at the London, a new physiology laboratory was in operation by January 1872. The hospital and medical school had opened on its new site on the Surrey bank of the Thames in 1871. The report of the committee[116] on the requirements of the school had recommended that all lectureships should be subject to annual re-appointment. Dr Ord and Dr John Harley, both assistant physicians to the hospital, were appointed jointly to the general anatomy and physiology lectureship. Lectures were to be given on three days each week in the winter, with practical physiology on two or three days each week in the summer session.

Ord and Harley had been required to list and cost the apparatus, diagrams etc. which they would require for their course.[117] They had also been advised to require their pupils to furnish their own apparatus or else pay a fee for the use of that belonging to the school. Both lecturers had been closely involved with the planning of the laboratory for practical physiology and had worked with Mr Currey, the architect, on its arrangements[118].

On 19th December 1871 Harley and Ord called together the students to introduce them to the newly fitted laboratory. The opening was reported in the *Medical Times and Gazette*[119] which included illustrations of the ground and sectional plans of the laboratory and a wood cut of one of the work tables. In his address Harley pointed out how fortunate they were in having ample space, abundant light, good ventilation, and a constant supply of hot and cold water

> the department of physiology enjoys the use of this spacious room . . . which contains sixty four work-tables, at which the same number of students may work simultaneously; of a large inner laboratory; of a private room . . . the whole occupying an area of nearly 2000 sq. ft., the rooms *en suite*, and the whole separate from every other department . . . two long skylights of clouded glass, which traverse the whole length of the roof give a most perfect light for microscopical work . . . the tables are so arranged that each student has command of a low argand gas-lamp for the microscope . . . [120]

Students were recommended to obtain a microscope either from Baker in Holborn, or Pillischer in New Bond Street. Ord and Harley had made suggestions to these suppliers who then furnished instruments with "coarse and fine adjustments, a simple roomy stage . . . a good quarter-inch object-glass and a single eye-piece"[121]. Pillischer's instrument cost £5, while Baker's, which included a box, cost £4 15s.

Harley gave a clear indication of the content of the practical course, reassuring his audience that vivisection would form no part of it but that " it is at the bedside, in the out-patient rooms, and in the pathological theatre that you must study experimental physiology"[122]. The work, he said, would be divisible generally into two great branches - microscopy, and physiological chemistry - "the former will embrace the examination of every tissue and product of the body, normal and morbid".

It was not until 1875 that it was thought desirable to appoint a demonstrator in physiology, Ord having remarked on "the great labour and time obliged now to be devoted to the courses in physiology and practical physiology"[123]. Mr J Cranstoun Charles, who had studied under Klein and been recommended by him, was appointed at a salary of £100 per annum.

Despite the fact that neither Ord nor Harley were full time physiologists, but supplemented their income by lecturing, the minute books record a deceptive ease with which they carried out their task. Parsons, in his history of the hospital and school[124], has suggested that all was not well in the physiology department. He pointed out that in about 1881, by which time Ord had relinquished his post,

> **the teaching of physiology was giving rise to a good deal of discussion since the subject was making such rapid strides that higher teaching in it could be given only by specialists . . . Harley and Charles had not the gift of keeping a large body of students in order, and thus very little could be learnt from them. To improve matters Mr Stewart, the curator, was appointed temporarily in December 1881 to give half the lectures, but the senior students quickly found out that, though he was a fluent lecturer, he had little practical knowledge of physiology [125] .**

When Stewart left St Thomas's in 1884, Charles became joint lecturer with Harley, on general physiology as well as on practical physiology. It was not until both men resigned, in 1887, that a physiologist, Sherrington, was appointed as sole lecturer.

As the *Medical Times and Gazette*[126] had pointed out at the end of the 1871-72 session, the facilities at Guy's Hospital Medical School were better than those found at most of the other schools. In 1871, at Guy's, Pavy had given notice to the Medical Council that changes would be needed in the teaching of physiology if it was to accord with the new regulations of the Royal College of Surgeons[127]. He proposed that a course of practical physiology should be given in the summer session, but pointed out that accommodation "beyond what exists at present" would be needed. The course, he said, should be in addition to the systematic course of lectures.

Philip Henry Pye-Smith [1840-1914][128], who had been a brilliant student at Guy's, had returned to the school as lecturer on comparative anatomy in 1865, and had become demonstrator on anatomy in 1866. In 1870-71 he had shared the teaching "on the use of the microscope" with Howse. In 1871-72, however, in response to Pavy's statement, this course was re-styled "practical physiology" and was taught solely by Pye-Smith, while Pavy delivered the systematic course of lectures on physiology.

Pye-Smith's detailed notes on histology, headed "Notes on the Microscope - from Dr Pye-Smith's Demonstrations of Practical Physiology", were published in the *Guy's Hospital Gazette* during 1875[129]. This remarkably detailed account is not in the form of a syllabus, such as Rutherford described at King's, but appears to be a verbatim account of what he said to accompany his demonstrations. His definition of histology, with which he introduced the course, encompassed all the definitions hitherto given to the subject -

> Human HISTOLOGY, the knowledge of the tissues (or textures) of the human body is also called Physiological Anatomy, because the functions of the organs are in most instances dependent on their minute structure, and General Anatomy, because as Bichat first showed, the same elementary tissues make up the apparently different organs of the body; and, lastly, Minute or Microscopic Anatomy, because the elements of these tissues are too small to be seen with the unaided eye. The instrument then, for studying Histology is the microscope.[130]

He began by describing the microscope, pointing out that those used in the class were by Beck, Crouch and Baker, but that, in his opinion, the best were Hartnack's. He went on to describe how tissues should be prepared for examination, recommending to his students Rutherford's *Notes on a course of Practical Histology for Medical Students*, the latest edition of Beale's *How to Work with the Microscope*, and the first volume of the latest edition of Quain and Sharpey's *Anatomy.*[131]

He defined the cell, having first discussed the history of the use of the term, as being "a minute mass of living protoplasm" and went on to describe the nucleus and the cell contents. He informed his students that the term "protoplasm", a word introduced by Max Schultz, answered "more or less" to Dr Beale's "bioplasm".[132]

He then described the elementary tissues - epithelial, connective, muscle and nerve, and gave instructions on how each should be treated with reagents, and what should be seen on examination with the microscope. His description of the histology of the various organs included that of liver[133]. He gave a detailed description of its microscopic structure as described by Kiernan and improved upon by other workers, particularly Chrzonszczewsky, a Russian histologist, and Hering. He gave instructions for preparing specimens for inspection with the microscope, including scraping fresh material and sectioning hardened and injected specimens.

In 1875, the year in which these notes were published, Pye-Smith took over part of the physiology lecturing from Pavy. In 1877 Pavy resigned the whole of his physiology to Pye-Smith, who, in turn, resigned his practical physiology to C H Golding-Bird.

Cameron records that it was when he succeeded Pavy that Pye-Smith's powers as a lecturer were most appreciated

> In a lecture delivered without notes and in the purest and most incisive English he could make plain the most complex subject... he took endless pains to translate and summarise for his class the work of French and German physiologists[134]

Cuthbert Hilton Golding-Bird [1848-1939][135], son of the Guy's physician Golding-Bird, had entered Guy's as a student in 1868 and, following his graduation, had studied in Paris. He had returned to Guy's initially as a demonstrator in anatomy. Cameron recounts that C H Golding-Bird's dexterity at section cutting with a razor was legendary.

The *Prospectus* for 1877-78 gives a detailed description of the courses delivered by Pye-Smith and Golding-Bird[136]. That of Pye-Smith was headed "Physiology and General Anatomy" and included "a study of the arrangement and minute structure of the component parts of the organs and tissues, as illustrated by specimens, drawings and diagrams". The practical course was described as "histological, comprising the elementary tissues and the chief organs of the body" and followed the pattern of Pye-Smith's published notes. The physiological chemistry was included in the summer course of practical chemistry and experimental physiology was stated to be included in the lectures in physiology, which was described as "exemplified by experimental illustrations". The prospectus also included details of the accommodation for teaching at Guy's, which had been extended and improved to include a new room for the teaching of practical physiology[137], which at Guy's at that time meant histology. Students were advised[138] that the second winter session should be devoted to gaining a thorough knowledge of anatomy, physiology, and histology, in preparation for the primary examination of the Royal College of Surgeons.

Golding-Bird published his "laboratory notes on the working of the histological class" in 1883 in *Guy's Hospital Reports*.[139] Whilst, he said,

> there is no royal road to histological ends, as far as I know, yet it is quite possible to indicate a line of procedure that is both simple and at the same time amply sufficient for all purposes of the medical histologist, and by which he may attain the best results

with the least expenditure of time and trouble.[140]

In his paper he described his method of working "that has worked well in this school for the past five years". He included what he believed to be "the best and shortest way of preparing tissues, cutting and staining sections etc." This was in fact a very succinct account of current good practice in histological technique, and included details of microtomy.

He concluded with "a sketch of the plan pursued here in the histology class" which indicated which material he used to demonstrate the various tissues and organs[141]. It is uncertain if this valuable paper reached a large audience, as it appears never to have been reprinted, but had it done so it would have provided a very effective aid to the teaching of histology in medical schools at that time.

Whereas the physiology courses at University College, King's College and elsewhere included not only histology but also physiological chemistry and experimental physiology, it is clear that at Guy's the emphasis, at least in the practical course, was on histology.

In May 1884, Pye-Smith proposed that there was an urgent necessity to appoint in his stead, a physiologist to lecture in that subject

> considerable discussion took place as to the expediency of appointing as lecturer in physiology, one who had specifically devoted himself to the subject, instead of following the usual course of appointing one of those already connected with the hospital . . . it was ultimately decided that it was not desirable . . . but that Mr Golding Bird should be recommended to deliver the winter course of lectures in physiology . . . it was further recommended that Dr Leonard Wooldridge should undertake the course of histology which would be resigned by Golding Bird and also to give a course of demonstrations in advanced physiology during the summer session for the candidates for the university examination.[142]

Leonard Charles Wooldridge had studied under Ludwig and Virchow in Germany, and his interests were physiological and pathological. Nevertheless it was the histology based course of practical physiology, which carried with it lower prestige and a smaller proportion of the fees which he was asked to deliver. The prospectus for 1884-85 shows that "demonstrations and instruction in normal histology will be given . . . each student will be supplied with specimens of all the tissues and organs ready for microscopical examination."[143] The fine detail of the course was not spelt out, but it included "instruction in the technical methods employed in microscopy". Only in the summer course, specially intended for students preparing for the higher examinations, would demonstrations in physiology and physiological chemistry be given. Further changes in the physiology courses at Guy's were only brought about by the need to respond, from 1885, to the requirements of the Conjoint Board of the Royal College of Surgeons and the Royal College of Physicians.

While the school at Guy's appeared to be quite confident that its courses complied with the 1870 regulations of the Royal College of Surgeons, both the school at St George's and that at The Middlesex Hospital sought advice from the Royal College on their interpretation, particularly of the requirement for practical physiology. The dean of the medical school at St George's wrote[144]

> I find from correspondence with the lecturers in Physiology at the various Medical Schools that great uncertainty exists amongst them, as to the steps which they must take in order to comply with the new regulations concerning the physiological lectures

He reported that, with regard to the practical course

> by some is supposed to mean merely the preparation and examination under the microscope of tissues and fluids - in fact a course in Practical Histology such as we have laterly always given at the school . . . in fact as far as I can learn no one really understands what is intended or required.

The Court of Examiners at the Royal College of Surgeons considered the letter and replied that

> the Practical course is intended to include Histology, Physiological Chemistry and Physiological Physics . . . the mode and, in some degree, the extent to which the course of experiment and observation may be carried must necessarily be left to the discretion and judgment of the Teacher and that the Court are not prepared to diminish his responsibility by laying down any precise directions as to the way in which he should fulfil his duties.[145]

This reply, while reassuring teachers that there was no requirement for them to become involved in vivisection, left the interpretation open. Not until their students entered for the Diploma of the Royal College of Surgeons, and the nature and standard of the examination was revealed, could teachers who were not members of the Court of Examiners, decide with any confidence on the content and balance of the physiology course which they were required to deliver.

It was from this position that William Ogle, the lecturer in general anatomy and physiology at St George's, was required to inform his Medical School Committee how he proposed to meet the requirements.[146] Ogle's detailed proposal[147] posed a number of questions and a variety of possible solutions

> **as regards the Histology which requires proper light, there is no available space so far as I can see with the exception of either the dissecting room or the gallery of the museum.**

He recommended the use of the dissecting room for a summer course or the museum gallery "should a winter course be thought advisable". He asked "Who is to give the practical instruction? . . the appointment of a separate lecturer to teach histology, physiological chemistry and physics . . . is most likely to be of advantage to the students". He again recommended that the course be taught in the summer term in the dissecting room, "which alone can accommodate the number of students".

The medical school committee decided that it would indeed be best to appoint a lecturer in histology, one in physiological chemistry, and that Dr Noah be requested to include physics in his chemistry course. They further decided that these lecturers would have to give fifteen practical demonstrations upon their respective subjects, to each second year student in the winter term; histology being given in the museum gallery.[148]

Dr John Cavafy, a former pupil at St George's, graduate of the University of London, and at that time medical registrar at the hospital, was appointed lecturer in histology. His course, entitled "Microscopical Anatomy" was described in the prospectus for 1871 - 72[149], as being given in accordance with the latest requirements of the Royal College of Surgeons. He gave his demonstrations to three separate groups of nine students each week.[150]

In that year Ogle continued to deliver the course of lectures in general anatomy and physiology, but in 1873 - 74 these were taken over by Cavafy, and the practical class devolved to Herbert Watney. Watney, who was a Cambridge graduate and had been a student at St George's, was a junior clinician at the time. He was appointed assistant physician in 1877.[151]

Cavafy, who had been appointed assistant physician in 1875, advised the medical school committee in 1879 that, on account of ill health, he was anxious to have some assistance in delivering the lectures on physiology. It was agreed that Mr Stirling would assist him[152]. From this time a succession of men, including Bennett, Wadham, Compton and Dent taught histology. Watney had resigned in 1883, but the committee were of the opinion that he should continue "in the interests of the school" and that he should do the work, as others did , even if it did not pay! It was understood, wrote the Dean to Watney, "that the medical officers supported the school as lecturers, otherwise the school would be broken up"[153]. Watney resigned from the hospital, and Dent who then shared the duties felt that he could no longer discharge his duties satisfactorily.

As a result of the difficulties that the school was experiencing, the Dean wrote to the Royal College of Surgeons asking them to expedite the publication of a syllabus of their requirements in physiology[154] [see page 350 below]. Meanwhile it was decided that histology would "placed under the superintendence of the lecturer in anatomy"[155], while the whole question of the teaching of physiology, including histology, was referred to a sub-committee.[156] This resulted in Dr Délépine, who was also a pathologist, becoming first, the demonstrator in histology, and then, in 1886, lecturer in physiology and general anatomy. Délélpine's demonstrator in histology was Me E le Cronier Lancaster. The histology that was taught in both 1885 and 1886 at St Georges was in accordance with the new regulations of the Conjoint Examining Board of the Colleges of Physicians and Surgeons [see below page 348].[157]

It is clear from the difficulties experienced at St George's and St Thomas's that unless a school was able to bring in specialist physiologists, or had the good fortune to have on its staff a man with a particular interest in histology, such as Golding-Bird at Guy's, the adherence to the requirements of the examining boards became increasingly difficult in the 1870s and 1880s.

A similar situation to that at St Thomas's and St George's existed at the Middlesex Hospital Medical School. The Middlesex, too, had carried on a correspondence with the Royal College of Surgeons respecting the interpretation of Note A to Clause 6, para III of the regulations for the Diploma of the College, in relation to practical physiology. The Dean had asked specifically

> **is it intended that the students shall be severally engaged in experiments upon living animals . . . if this is not desired what are the necessary experiments, manipulations, etc., supposed to include . . .[158]**

The reply[159] was almost identical to that received by St George's.

A sub-committee of the Medical School Committee had been set up to consider "the best mode of conforming to the new regulations"[160]. The report of this sub-committee which included the treasurer, the dean, Mr de Morgan, Dr Ferrier and Dr Caley, was read in December 1870[161]. It recommended that Dr Ferrier and Dr Caley divide the practical instruction between them, the former taking the histological part. It also recommended that the course be conducted in the summer session in part of the dissection room, and that a special fee for attendance at the course be charged. The medical School Committee decided to find out what other schools were proposing before deciding on charging a fee, but otherwise adopted the report.[162]

In January 1871 Ferrier left the hospital and school, having been appointed to King's College. He was succeeded by Benjamin Thomson Lowne, who had been a student at St Bartholomew's.[163] It was not until March 1871 that the sub-committee met to consider the best means of forming a laboratory for practical physiology. It had examined "the convenience of the practical chemistry room and the dissecting room and felt that the latter would be most suitable". It recommended that a wooden screen with a door be fitted across the room and the northern end be fitted up as a physiology laboratory[164].

In May 1873 Caley reported that there were only five microscopes for the use of the class which then numbered twenty students. It was resolved that each student should provide his own microscope or pay £1 1s 0d for the use of one of the school instruments and that the purchase of new microscopes be limited to £8 8s 0d.[165]

Caley gave up his part of the teaching of practical physiology when he was promoted to full physician in 1876, from which time Lowne had sole responsibility for physiology. There is no evidence in the medical school records of Lowne's skill as a teacher, nor of any contribution he may have made to physiology or histology, his specialism and publications being on vision and on ophthalmic surgery. He was however an examiner in physiology at the Royal College of Surgeons.

In 1882 Lowne recommended that

> in consequence of the new rules of the College of Surgeons, I think it will be advisable for the benefit of the school that the physiological classroom should be open for microscope work all the year round, during the session at least. In order to do this, and also as tutor of physiological subjects, I think we should have a demonstrator in physiology.[166]

This proposal was supported by the sub-committee for physiological teaching, but the necessity for formulating it at all suggests that at the Middlesex, the histology taught in the 1870s and the early 1880s was just sufficient to satisfy the examining boards and no more.

At St Mary's Hospital Medical School also, a sub-committee was appointed to recommend a strategy for complying with the Royal College of Surgeons requirements for physiology[167]. It appeared to have no difficulty in interpreting the new regulation. It recommended that physiology should be taught in two courses: the first a practical course

> consisting mainly of histological demonstrations, with so much physiological physics (e.g. the physics of the circulation) and of physiological chemistry (e.g. volumetric analysis of urine etc.) as the lecturer may find it practicable to give in addition;

and the second a course of systematic lectures. The practical demonstrations were to be given to students in their first year, the lectures in their second year.

The sub-committee recommended that Dr Lawson should give the lectures and Dr Nunneley the demonstrations. Both teachers were assistant physicians to the hospital.

Nunneley promptly applied for a grant of £29 8s 0d for four new microscopes and for permission to have "certain small improvements made in the histological laboratory"[168], and the school was able to advertise in its prospectus for 1871-72 that

> The Students are carefully trained in the use of the Microscope; and the Minute Anatomy, both of healthy and morbid tissues, is demonstrated in the Medical School in Classes devoted to these subjects. A HISTOLOGICAL ROOM has been specifically fitted for the purpose, and is open daily under the superintendence of the lecturers on Normal and Morbid Histology.[169]

It is not clear what practical work students were expected to perform for themselves in Nunneley's classes, although the emphasis was clearly on demonstration. In the prospectus it was stated that

> this course comprises a description of the minute structure of the tissues and organs of the body in a series of microscopal [sic] demonstrations at which practical instruction in manipulation will be given[170]

The fact that Nunneley gave the practical demonstrations, including those of the structure of organs, a whole year before Lawson's systematic lectures, suggests that there was little attempt to link theory with practical experience. This was in spite of the recommendation of the sub-committee, in July 1871, that regard be had "to the importance of the study [of normal and morbid histology] as a link between physiology and medicine".[171]

In the pathology classes in 1871-72, given by Dr Cheadle, also an assistant physician, students were advised to provide themselves with microscopes. This advice was extended to students in the physiology classes following the adoption of a regulation requiring "those students who should not be furnished with microscopes of their own to pay a fee of one guinea for the use of those furnished by the school"[172].

At the end of the 1871-72 session Nunneley resigned on account of ill health. That his post was seen in the school as being on histology rather than the broader subject of practical physiology, is clear both from the medical school minutes[173] and from the report of the dean for that year. The dean described Nunneley's resignation as "a serious loss . . . Dr Nunneley, lecturer in histology, has proved so satisfactory, both to his colleagues and to his students during the short time he has been amongst us . . . "[174]

The medical school committee recommended to the Weekly Board of the hospital that Dr A B Shephard be appointed "lecturer in histology", no mention being made of other aspects of physiology[175]. The prospectus for 1873-74, however, shows that some changes were made to the pattern of classes but that the emphasis was still on demonstration. The course on "Histology and Experimental Physiology"[176] was compulsory for first year students, but a second, voluntary class was offered to second year students . . .

> each course consists of about 35 demonstrations of which 30 must be attended by First Year's Students in order to obtain the necessary Certificate for the College of Surgeons (Sect 2, iii 6, & Note A). A few lectures may be devoted to experiments in illustration

of physiological phenomena.

The individual practical work was clearly expected to be carried out in the student's own time:

> The Histological Laboratory is open during the Summer session, under the superintendence of the lecturer, to advanced students who wish to improve their knowledge of the more delicate tissues, and of the methods of manipulation.

That the room used for histology was inadequate is clear from a report[177] made to the school committee in 1875, proposing the modification of the upper floor and the incorporation of a well lit landing into a new "histological laboratory". The size of the original room can be judged from the suggestion in the report that it might be used as a waiting room and lavatory for the lecturers!

While the school thought that practical physiology was being adequately taught, the same could not be said of the lectures. Lawson had complained of disturbances in his classes and this was found by a sub-committee to be "not wholly due to fault of students". In March 1877 Lawson was told that his work was unsatisfactory, "only 51 lectures delivered in the present session and some departments of physiology not entered upon"[178]. He was asked to resign in the interests of the school and this he did in September 1877.

Walter Pye [1852-1892][179], who had been a student and then house surgeon at St Bartholomew's was appointed as lecturer in physiology. It is significant that it was the physiology appointment which preceded his appointment to the surgical staff at St Mary's, rather that the other way round, which had been the general rule.

Pye illustrated his lectures with diagrams, microscopical specimens and models. At the same time Shepherd continued his practical physiology, now taught in two parts, the first dealing with the use of the microscope and with the elementary tissues, the second with organs and systems. Each member of the class was required to provide himself not only with a microscope but with all the apparatus, such as slides, coverslips, needles and brushes, needed for microscopical investigations and for preparing and mounting specimens[180].

This is the first clear indication of students at St Mary's performing these exercises for themselves. This, while satisfying the requirement of the College of Surgeons, was more than twenty years after similar classes had been instituted at University College.

Shepherd resigned in 1880, and the dean was authorised to find out if Mr Pepper would accept the class if it was offered to him[181]. Mr A J Pepper, a supernumerary assistant surgeon, accepted the appointment, which he held for two years, until appointed lecturer in practical and operational surgery. The school could attract no applicants to fill the vacancy, and the dean was requested to "communicate with professors of the different universities with a view to obtaining a competent teacher"[182]. There is no record of this having produced any names.

It was at this time, in March 1883, that the medical school committee reported that

> the present school buildings are inadequate to the requirements of the day. The advance of Medical Education during the last twenty years renders a greatly increased space absolutely necessary to enable the teachers to comply with the regulations of the examining boards, and to prepare the students for their examinations. Without such additional accommodation the proportion of rejections is likely to increase, the reputation of the school will suffer, and it will fail to attract students, as it has hitherto done[183].

It was calculated that £4000 would be needed if the proposed improvements were to enable St Mary's to compete on even terms with the other metropolitan schools. The Weekly Board loaned the necessary funds for enlargement and improvement of the medical school with the medical school committee being required to pay the interest on the loan. At the same time Pye was given leave to look out for suitable apparatus for the new physiological laboratory[184]. It was not until May 1883, however, that a demonstrator in Physiology, Dr S Nall was appointed.

The prospectus for 1883-84 included the establishment of the new "physiological department". The course of study to be pursued by the student included

> in the first half of the first winter he will attend lessons with demonstrations in Elementary Physiology given by the demonstrator, and will be expected to show to the satisfaction of the lecturer that he has thus acquired a knowledge of the first principles of physiological science before he may proceed to practical Histological

work. In the second half of the first winter the methods of Microscopic Anatomy will be practically studied under the demonstrator and the lecturer . . . In the second winter session the students will attend the systematic course of lectures . . . illustrated as far as possible by experiments, specimens, etc., in the physiology laboratory. They will on fixed days prepare and study the histology of the compound organs and glands . . . [185]

It should not, though, be thought that this new, well structured course was the concept of Walter Pye. Rather, it owed a great deal to further requirements of the Royal College of Surgeons [see below, page 350]. In fact, the students at St Mary's complained in 1884 that "Mr Pye's teaching is in many respects at variance with that of modern text-books.[186] As a result a sub-committee, chaired by Handfield Jones, was appointed to look into the teaching of physiology in the school.

The sub-committee recommended that "alteration in the present mode of teaching Physiology and Histology is urgently needed and that a separate Physiological Laboratory be provided". It also recommended that "the Lecturer on Physiology should be an expert in that Department, one who devotes his whole time to the subject and who, in return, shall receive a higher and special salary". This was to be seen not as a reflection on Pye's competence, but as an acknowledgement that the task of teaching physiology required more "than could be expected from anyone engaged in Hospital work and entering on a surgical career"[187]. In consequence Pye was appointed lecturer in operative surgery and resigned his physiology post.

It was decided, in May 1884, to advertise the post and to offer £300 per annum to a candidate of sufficient standing. As a result, Dr A J Waller, was appointed to take over the physiology department.[188]

Westminster Hospital Medical School, like St Mary's, attracted young men trained at other establishments, to its clinical and lecturing posts. William Henry Allchin [1846-1912][189] had been a student at University College from 1865 to 1869 and had then served as medical officer on *S S Great Eastern*. He had returned to University College as lecturer in comparative anatomy in 1871, having graduated MB from London University. Allchin's long connection with the Westminster Hospital and Medical School began in 1872 when he was appointed medical registrar and, as demonstrator in histology and practical physiology, to assist Maclure, the lecturer in physiology. Allchin's obiturist recorded that "he threw all his energy into the task for which he was eminently fitted by his previous training and experience at University College". In May 1873 he was appointed the first lecturer on pathology and morbid anatomy at the Westminster School, and in the following year added the teaching of dental anatomy, physiology and histology to his role. He became physician to the hospital in 1877 and in 1878 he succeeded Maclure as lecturer in physiology, resigning the latter post in 1882 to become joint lecturer in medicine.

When Allchin became lecturer in physiology, Murrell and then North took over the course in histology. William Murrell [1853-1912][190] had also been a student at University College. He had held the Sharpey Physiological Scholarship there, and, after qualifying in 1874, he had assisted both Burdon Sanderson and Schäfer as demonstrator in physiology. In 1877 he moved to the Westminster Hospital School as lecturer in histology and practical physiology, although his chief interest was pharmacology.

William North[191] had been a Sharpey Scholar at University College from 1879 to 1881, following his graduation from Cambridge in 1878. In the session 1881-1882 he acted as joint lecturer in physiology at the Westminster.

Given the poor start that was given to students in histology and practical physiology in the early 1870s[192], the succession of able young men from University College can only have led to a great improvement in the teaching of this part of the curriculum.

Charing Cross Hospital Medical School was not so fortunate. There a succession of non-specialist clinicians had responsibility for the teaching of physiology and of histology. Dr Silver had transferred to the chair of physiology from that of forensic medicine in 1869. From the record of the minute books of the school it would seem that physiology teaching survived in spite of Silver's appointment, rather than as a result of it.

Silver had nominated Mr J Mitchell Bruce as his demonstrator in practical physiology in July 1871[193]. Bruce was reappointed "demonstrator in histology", with an honorarium of £20 per annum in 1872[194]. He lost little time in informing the dean that the laboratory was too small for practical teaching. He suggested that the pathology museum could be used if provided with some tables and chairs. He added that the number of microscopes was "perfectly inadequate for the wants of the class"[195].

Bruce resigned from his post as demonstrator in 1876. It is obvious from his letter of resignation that he had not been happy in the post - "the committee will I am sure agree with me, that I have occupied the post sufficiently long both for my own sake and in the interests of the school".[196]

Bruce was succeeded by Dr Cantlie in October 1876 and Mr Whitehead was given an honorarium of five guineas for a year as assistant demonstrator in histology. One year later the demonstrator's post was filled by Mr D Colquhoun, with Mr Webb as assistant. It was not until 1879 that Silver proposed to reorganise the department[197]. It is not clear at whose instigation Silver prepared his plan, since it reflected the then current pattern of working quite closely, and emphasised his own supervisory role. He proposed that the lecturer in physiology should be entirely responsible for the teaching, but that two assistants should be appointed as demonstrators. One of these would have the duty of "teaching and practical education of students in Histology and more generally the use of the microscope" - this to be mainly summer work. The other would give tutorial instruction in physiology and "such demonstrations as may be considered necessary in physiological chemistry and physics." Silver also recommended that a fee of two guineas be charged for practical physiology "in accordance with the practice of many other London hospitals". He recommended that this fee be equally shared between the two demonstrators.

A sub-committee was formed to consider Silver's scheme which was adopted with the comment

> that considering the increased importance of physiology in the examinations of the College of Surgeons, it is desirable that additional teaching power be provided in this subject in the school[198].

It is quite remarkable that it was not until 1879 that this conclusion was reached!

A further report of the sub-committee was prepared in May 1881[199]. In this it was recommended that a chair of practical physiology should be instituted, and that, although the chairs of theoretical and of practical physiology were to be distinct, it was thought desirable that the teaching of the two courses should be, as far as possible, concurrent. The duties of the new professor of practical physiology would be to teach experimental physiology, physiological chemistry and practical histology. This report was printed and circulated to the medical school committee for discussion on June 10th 1881, just a decade after regulations which invited such a course of action were published by the Royal College of Surgeons. It is not clear who was the driving force behind the report. It clearly was not Silver, since as each resolution was discussed and voted upon, he dissented![200] Shortly after the meeting he wrote to the committee "compelled in the interests of the chair I hold to enter a formal protest against the scheme adopted"[201] .

Nevertheless the committee went ahead with the scheme, and Mr R Norris Wolfenden was appointed to the new post for one year. He was authorised by the committee, rather than by Silver, to expend £25 on materials. In April 1882 Wolfenden applied for additional microscopes and the sum of £50 was voted "for at least ten microscopes"[202]. It was resolved at this time to charge a fee of one guinea to students who did not possess their own instrument.

The situation in the department could hardly have been conducive to good teaching and learning. Silver, however, died suddenly in July 1882, and Bruce proposed that Wolfenden be asked to take over the class of physiology and to superintend the practical physiology. This was agreed and the post of demonstrator was advertised. Mr H B Shaw was appointed.

With all the changes and undoubted hostilities in the physiology department it was not surprising that it was unable to cope with further changes required by the College of Surgeons. In June 1884, following a large proportion of students failing the Primary Examination of the RCS, taken at the end of their first year, another sub-committee was established to enquire into the causes.[203]

Their report was damning:

1) the students in their first year are too ignorant of the collateral sciences to be capable of understanding the lectures in physiology
2) that no course of physiology or histology, recognised in the prospectus, is given during the second winter session
3) that although the summer course in Histology is fairly satisfactory, the laboratory arrangements are evidently defective and without proper supervision
4) that physiological chemistry is not taught practically
5) that the laboratory is in such a state as almost to preclude work in it

As a remedy to the situation in histology it was recommended that additional teaching be given during the second winter and that to enable practical courses to be carried out, arrangements be made for more constant supervision of the laboratory, and that it be maintained in working order.

The duties of demonstrator were clarified, including that

a) he conduct during the winter session a class of Elementary Physiology for first year's students consisting of not less than three meetings a week and including :
- A. lectures on elementary subjects
- B. elementary physiological chemistry
- C. elementary histology[204]

One result of this report was that Wolfenden resigned and Mr F W Mott was appointed in his place.[205]

It would be unfair to suggest that it was only at Charing Cross that the changes to the regulations of the Royal College of Surgeons in 1884 necessitated a reordering of the teaching programme. All the schools would have had to make some adjustments, but those with effective teaching in physiology, including the teaching of histology, would have experienced few problems in so doing. In schools which were already struggling, however, the difficulty in addressing that part of the curriculum would have been compounded. As it was, those schools and colleges, such as University College and St Bartholomew's, where specialist teachers taught histology, and where appropriate funding and accommodation was provided, went from strength to strength, while others such as Charing Cross found that expertise amongst their clinical staff no longer matched the requirements of the examining bodies.

The Conjoint Scheme

The changes which caused the schools to reorder their teaching in 1884 were a product of the "Conjoint Scheme". This had been the subject of debate in the General Medical Council, the various licensing bodies, and in the schools since 1870. The intention was, initially, to construct a "single portal" through which all prospective practitioners must pass prior to registration.[206]

Newman has made a detailed analysis of the events between the Medical Act of 1858 and that of 1866, which sought to ensure that only persons who had qualified in all three subjects of medicine, surgery, and midwifery could register as general practitioners[207]. He commented that

> the work of the Committee of the General Medical Council in 1869 on the subjects of medical education, the order of their arrangement, and the organisation of examinations had decided that "one of the great evils at the present moment is the inequality of the examinations for licence" and had recommended, to remedy the defect, a "Conjoint Examining Board for each division of the kingdom, before which each person who desired a licence to practice should appear, and by which he should be examined in all subjects"[208]

The English Conjoint Board was the Examining Board in England for the Royal College of Physicians of London and the Royal College of Surgeons of England. It was set up by the Colleges in 1884 to control the examination leading to its Diploma. This consisted of the Membership of the Royal College of Surgeons and the Licentiateship of the Royal College of Physicians, and provided a licence for the general practitioner.

The Lancet[209] commenting, in 1886, on recent changes in medical examinations in England said

> Although the advent of a uniform one-portal system of examination has been indefinitely postponed, if not made impossible by the recent Medical Act, yet a fairly near approach thereto is now offered to medical students by the combinations of some of the corporations for examination purposes. The Conjoint Examining Board in England of the Royal Colleges of Physicians and Surgeons has practically become the one-portal system of English medical men, and most English students will enter the profession by passing the examinations held under the supervision of this authority

An overview of the professional requirements in medical education prior to the establishment of a Conjoint Examining Board was set out in a special student number of the *Medical Times and Gazette* published at the beginning of the medical session 1875-76[210]. This provided a student with a comprehensive guide "from the time of his entering the ranks of student life up to the period of qualification and registration". It included details of regulations of bodies granting the degree of Doctor of Medicine, which included the University of London, and of those bodies giving licences or other forms of qualification not being degrees in medicine. This latter group included both the Royal College of Physicians and the Royal College of Surgeons.

The University of London required, as part of its MB examination, certificates to the effect that candidates had attended three from a list of subjects which included general anatomy and physiology. The Royal College of Physicians listed physiology amongst its subjects to be studied, while the Royal College of Surgeons required certificates to record attendance at both theoretical and practical courses in general anatomy and physiology.

In the advice to the student beginning work, the editors, with regard to physiology, pronounced themselves

> almost reduced to despair . . . the absurd existing regulations compel a man . . . to study the minute structure of a part of an organ with whose shape or outward appearance he is altogether unacquainted[211]

It is perhaps remarkable that an alternative editorial view was expressed in the very next issue of the journal when "the present system of medical education" was reviewed[212]

> not many years have passed since anatomy and physiology were taught in one course and by one lecturer, but now we have not only a course of physiology, but a separate course of practical physiology or histology, and a most useful course it is . . . an accurate knowledge of the minute structure and microscopical appearance of the normal healthy tissues of the body is absolutely necessary to the student, as unless he is well acquainted with the healthy structure he will be unable to recognise the unhealthy ones . . .[213]

The conflict between the desirability of such a course and an effective means of delivering it was not resolved until the regulations for the examination for the new conjoint diploma provided for an examination in elementary anatomy and in elementary physiology to be taken at the end of the first year of study, and a further examination in these subjects to be taken at the end of the second year, prior to any clinical studies being undertaken.

The new regulation applied to all students beginning their studies on and after October 1884. A search of the minutes of the Council of the Royal College of Surgeons, however, reveals that the first step towards the establishment of an examination in elementary physiology, which would include some aspects of histology, had been taken in 1882[214]. The committee set up to prepare such an examination had reported, however, that the proposal was impractical and would involve an additional charge to students. The committee proposed that an examination should, instead, be instituted at the various recognised schools, at the end of the first year of study[215].

The exact position of histology, particularly practical histology, still remained unclear, however. It was at the same meeting of the Royal College of Surgeons Council that the observations of the General Medical Council and its Visitors on the examinations for 1881-2 were reported.[216] The report included the statement

> The Council believe that the Physiological Examination is in accordance with the method of teaching physiology now adopted in the medical schools, and is therefore a fair test of the acquirements of students.

But in relation to histology . . .

> it may here be observed that the Visitors (at p.16) appear almost to complain of the introduction of "stained microscopic preparations," and of "manipulations of microscopic tissues into the Physiological Examinations;" whereas, in their 9th conclusion (p. 56), they assert that "a practical knowledge of the histology of tissues and chief organs" should be required by all Candidates.

At the meeting of the Council of the Royal College of Surgeons in June 1882[217] it was resolved that the attention of the medical schools should be drawn to the fact that the Council had resolved that "it is desirable that an Examination in Elementary Anatomy and Physiology should be instituted at the several recognised Schools of Medicine after the end of the first year of professional study". It was decided that teachers should be invited to confer with the Joint Committee of the College to consider the mode of carrying out the proposed examination.

In August 1882, the Joint Committee reported that twenty nine teachers had attended the meeting, and letters had been read from several others unable to be present, and that the subject had been fully discussed.[218] The teachers had agreed that the institution of an examination by teachers in the medical schools was desirable, and that candidates should be required to produce certificates to demonstrate that they had passed this examination at the end of their first year. Significantly though, it had been agreed that "it be left to the Teachers at the several Medical Schools to determine the nature and extent of the Examination in Elementary Anatomy and Physiology"[219]. This last condition meant that if a teacher either could not or would not reorganise his teaching to comply with the spirit of the changes, no change need in effect be made, other than actually carrying out an examination.

In March 1883, a report of the Committee of Delegates appointed by the Royal College of Physicians and the Royal College of Surgeons regarding a scheme for constituting an Examining Board in England was read.[220] It was proposed that there should be three examinations, "each being partly written, partly oral, and partly practical". The subjects for the first examination included elementary anatomy and elementary physiology, the two subjects to be examined separately. The second examinations included anatomy and physiology, again to be examined separately. It was also proposed that synopses should be prepared indicating the range of questions in these examinations[221]. This was an innovation - previously the Royal College of Surgeons had given no indication of which areas in any specific subject would be examined. No longer could the medical schools decide for themselves what should be taught or when, if their candidates were to be successful in the examinations in the "conjoint scheme".

The proposed scheme included regulations for professional education as well as for examination. These were, at first glance, less prescriptive that hitherto. They included the attendance at a course on General Anatomy and Physiology during not less than six months, or one winter session, and a separate practical course on General Anatomy and Physiology during not less that three months. With the advent of the new examinations, each with a synopsis of content, it was no longer necessary to spell out exactly what was intended in the different courses, the examinations themselves dictated this.

The proposals were adopted by both Colleges and new regulations published[222]. The synopsis "indicating the range of subjects in the Examination in Elementary Physiology" included

1. The recognition, under the Microscope of the Elementary Tissues, namely:-
   (a) Fibrous (including Elastic) Tissues. (b) Adipose Tissue. (c) Epithelium. (d) Bone. (e) Cartilage. (f) Muscle. (g) Nerve-Fibres and Cells. (h) Blood.

N.B.- No Histology will be required beyond that which is included in the recognition of the above Tissues.

The subjects required at the second examination included

1. HISTOLOGICAL.
The Structure of the Tissues of the body; the Structure of the Organs of the body; recognition of microscopical preparations of the Tissues and Organs.

It was also stated that a practical acquaintance with the methods of microscopical and chemical examination would be required.

The examiners for the new examinations were selected at a meeting of the Nominations Committee[223]. For elementary physiology, Fenwick of the London Hospital, Golding-Bird of Guy's, Halliburton of University College, Dormer Harris of St Bartholomew's, Hutchinson of the London, D'Arcy Power of St Bartholomew's, and Wooldridge of Guy's were all nominated, but Golding-Bird was the only man to be recommended to and elected by the Council.[224] The name of Fenwick was added to that of Golding-Bird later in the year.[225]

For Physiology, Morrant Baker of St Bartholomew's, Golding-Bird of Guy's, McCarthy of the London, Henry Power of St Bartholomew's, Schäfer of University College,and Yeo of King's College were nominated. Power, Baker and Yeo were elected.[226]

These names of relatively young teachers of physiology selected in 1884 to examine that specific area of the medical curriculum for the Examining Board in England contrast both in age and experience with those who, in 1870, had been the members of the Royal College of Surgeons Court of Examiners, namely, Fergusson, Busk, Skey, Partridge, Hilton, Richard Quain, Cock, Solly, Adams and Lane.[227]

The examination questions themselves also reveal the change in emphasis to encompass current methods and content in the teaching and learning of physiology, including histology.

A brief analysis of the examination papers set by the Royal College of Surgeons during the period 1870-1886 shows that prior to the conjoint examinations it was possible to avoid all questions which included an element of histology. The candidate was required to answer at least four out of six questions, never more than one of which was specifically histological. A histological question, when asked however, could be quite searching, for example

> What is the structure of adipose tissue? and what uses does it subserve? State where it is usually most abundant, and in what situations it is always absent. The answer to include the microscopic characters of the tissue and the chemical composition of fat.[228]

and

> Describe the minute structure and functions of the Retina.[229]

It would be possible to make a detailed analysis of the examination questions set by the Royal College of Surgeons and the Royal College of Physicians during this period, in an attempt to identify both the extent and the nature of histological knowledge required by the examiners. The one thing, however, that cannot be determined from a study of examination questions is the level of understanding and the amount of detail considered by the examiner to be necessary to demonstrate a candidate's proficiency. For example, a question on the liver -

> Describe the structure of a lobule of the Liver. What are the functions of the Liver[230]

could be answered at a variety of levels.

In 1885 the conjoint examination papers for elementary physiology included the recognition of three specimens of tissue shown under the microscope. The candidate was required to say by what characteristics he had recognised each tissue. The second physiology examination was more difficult and the candidate required an understanding both of histology and its role in physiology to answer the questions satisfactorily. In addition, although a candidate had to answer at least four questions he could with advantage answer all six. Typical of these questions are -

> Define the term "Cell." Describe its structure. Classify Cells according to (a) their shape, (b) their function.[231]

> Describe the Circulation of the Blood through the Liver. Give the structure and functions of the hepatic lobule.[232]

> Give the microscopic structure of a Striated Muscle-fibre. How may a Muscle be excited to contract? What phenomena accompany Contraction?[233]

Textbooks to support the teaching of histology

The student number of *The Lancet* in 1886 included an editorial comment headed "The choice of a text-book"[234]. It acknowledged that the number of medical textbooks of a high class was very great and that to select a few from amongst them might have seemed invidious. Nevertheless, taking as representative of the various examining bodies the Examining Board for England and the University of London, a list of texts was given "as a guide to the student in his choice". For the second examination of the Examining Board for England, Histology "apart from the sections devoted to it in the works of GRAY and KIRKES, may be read in KLEIN's elements" For the histological element of the University of London Intermediate MB examination, the text of Schäfer was recommended in addition.

This was but one view however, and the student was advised to be guided by the opinion of his teacher. Forming such an opinion would not have been easy since between 1871 and 1886 barely a year passed without the publication of a new volume or new edition on histology. Some of these were detailed treatises on the structure of the body; some were student texts which approached histology in both a theoretical and a practical manner, either in a more general volume on physiology or in one devoted specifically to histology; others were practical manuals published initially in response to the Royal College of Surgeons regulation of 1871, requiring students to undertake for themselves practical work in histology.

In the first group the works of both Stricker and Frey would have been valuable, not only to the student, but also to the teacher in his preparation of lectures. Stricker included, in the second volume of his manual,[235] published in 1872, an excellent monograph on the liver by Hering[236]. Hering's account of the structure of hepatic lobules, corroborated by Kölliker, differs from those given by others, namely, that the networks of capillaries and of gland cells interpenetrate one another. A review[237] of Stricker's manual in the *Monthly Microscopical Journal* said that

> we cannot but award the highest praise to Dr Stricker . . . in producing a work which . . . is without doubt the finest treatise of the kind which has yet been issued by any

> printing press in the world. Histological readers will recollect that it is exactly twenty years since the first volume of Kölliker's manual appeared in this country . . . that work was considered much too far advanced for anyone but the special student of Histology. Yet, Kölliker is as much behind-hand now, when compared with Stricker, as he was foremost at the date we mention.

The two texts by Frey, one on the microscope and microscopical technology[238], the other on the histology and histochemistry of man[239], had the advantage over Stricker's work of being written by a single author. Frey's work on histology, translated by Barker, surgeon to the City of Dublin Hospital, dealt sequentially with the elements of composition and structure, the tissues, and the organs of the body. Histology was seen by Frey as a special branch of anatomical study, and the work was set in a structural rather than a physiological context. His consideration of the structure of the organs he termed "Topographical Histology"[240].

In his description of the liver, Frey quoted the "elegant demonstrations of Hering". He pointed out that many workers

> supposed the bodies of the hepatic cells to be always interposed between the blood and biliary capillaries, so that these two never come into contact one with another

and that the discoveries of Hering, supported by his own researches, led him to believe that this was correct.[241]

The review of Frey's text in the *Medical Times and Gazette*[242] remarked that

> It has long been matter for complaint that we here in England had no book for reference or study which dealt in a manner at all comprehensive with human histology. In many respects that portion of "Quain's Anatomy" which was devoted to general anatomy answered the demand fairly well; but beyond this sketch admirable though it was, nothing was to be had. A year or two ago we had the further boon bestowed upon us of an English edition of "Stricker's Histology", but this was a step further than we contemplated; it wanted that compactness, that unity of thought, which is the special gift of the books of one master . . .

It was recommended to advanced students "assuring them that they can have no better guide to the study of histology". This was quite true, it did serve that need, but it was probably too detailed for the average medical student, and even perhaps for his teacher, who would have found *Quain's Anatomy* more approachable.

The second part of Frey's text on the microscope would have been much more valuable to a teacher, describing as it did "how to prepare for

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FIG. 135.—Vertical section of liver of rabbit, the portal vein and hepatic duct of which are injected. *a.* Interlobular blood-vessels. *b.* Interlobular bile ducts, forming a network. *c.* Intralobular capillary blood-vessels. *d.* Intralobular bile capillaries. *e.* Liver cells, the nuclei of which are deeply stained with carmine. p. 126. (Oc., 3; Obj., 5.) (*See* also fig. 142.)

Figure 10.
E Klein et al - *Handbook for the physiological laboratory.*
London: Churchill, 1873.
Plate LXII.

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examination the several tissues which make up man's body, and then how to observe the various structures so brought out"[243].

Frey's *Histology and Histochemistry of Man* was selected, together with Klein's contribution to Burdon Sanderson's *Handbook for the Physiological Laboratory*[244], by the *British and Foreign Medico-Chirurgical Review* for its discussion of "The Teaching of Histology" in 1875[245]. The two books were selected as illustrating the "systematic" (Frey), and the "practical" (Klein) modes of approaching the teaching of histology. Frey's work was regarded as the legitimate successor to Kölliker's manual, while Klein's section of Burdon Sanderson's very practical handbook was shown to differ widely in its approach. Even so

> though professing to deal only with methods of investigation, the work contains much teaching of a dogmatic kind. The student is told what he will see as well as how he should set about seeing it.

The reviewer also felt that Klein's illustrations were

> *too* good for the purpose for which they are intended . . . diagrams or rough sketches are sometimes better than true pictures for elementary instruction

and felt that this portion of the handbook was better suited to the wants of the advanced student and the original worker than those of a beginner.[246] [See fig. 10] The only scheme, he felt, under which the ordinary class could be guided through the entire subject during the limited time available for the purpose was that followed by Rutherford during his tenure at King's College and published in the *Quarterly Journal of Microscopical Science* in January 1872[247].

Burdon Sanderson's handbook was, however, specifically described by its editor as being intended for beginners in physiological work . . . "It is a book of methods, not a compendium of the science of physiology"[248]. The publishers of the volume had "judged it expedient" to separate the illustrations from the text. It was claimed that in this way full justice was done to the engravings of the histological part, which were executed from the original drawings of the author.[249] In practice though this arrangement was inconvenient. Klein, for his study of liver, had teased out fresh material and had prepared specimens from hardened tissue stained in carmine. Separating his descriptive text from the illustrations detracted from the usefulness of both.

It has to be remembered though, that at the time of its publication the handbook was unique, dealing as it did with a broad range of practical physiology. As a review in *The Lancet*[250] pointed out

> The improvement in physiological teaching during the last few years has been something wonderful. The teachers of the last generation . . . thought they had done their duty when they had shown the principal tissues, under one or perhaps two microscopes, to a class of fifty or a hundred men . . .

A new edition of Rutherford's *Outlines of Practical Histology*[251] was published as a textbook in 1875, by which time the author had moved from King's College to Edinburgh. Rutherford, in his introduction stated that

> a course has been adopted, whereby students in classes, numbering from twenty to thirty, can be conducted through the leading points of practical histology in about thirty lessons, each lesson extending from an hour to an hour and a half[252].

The text was so precise and detailed that it could have been used as a model by teachers. *The Lancet* remarked that "this book should be in the hands of every student"[253], but *The Monthly Microscopical Journal,* the journal of the Royal Microscopical Society, was critical of the work, particularly of its lack of illustrations (Rutherford had stated in his preface that his figures were reserved for his larger work on practical physiology) and its exclusive use of one make of microscope, namely Hartnack[254].

Rutherford's second edition[255], in 1876, remedied both deficiencies to some extent, but the description of the practical study of the histology of the liver, although giving details of the techniques for preparing specimens in order to demonstrate various aspects of microscopical structure, still lacked illustrations. This would have meant that a student, in order to interpret his preparations, would need to have access to another, illustrated, text.

The texts of both Klein and Rutherford were included in the review of textbooks on practical histology which appeared in the *British and Foreign Medico - Chirurgical Review* in 1877[256]. This review acknowledged the fact that practical histology had become part of the regular curriculum of medical students, and that

> it may be worth while to inquire what knowledge of microscopical details it is fair to expect the average second or third year man to acquire from his own work, with the time at his disposal, and whether this knowledge when gained, is of such an extent as to be of practical value to him in after life.

It questioned whether practical teaching of histology could not be better done, and with greater economy of time, by a well-arranged course of demonstrations. It surmised that if such a course was made imperative for all, there would be no lack of students who would be stimulated to work for themselves with the microscope. It was for these men, it was felt, that a good course of practical histology was capable of being a training which would be useful to them in their professional work. It was not, however, for such a group, but for the majority of men who needed to pass an examination and become qualified practitioners, that the various textbooks were considered.

Klein's contribution to the *Handbook to the Physiological Laboratory* was praised, but

> altogether we cannot but think that the author has missed a great opportunity, the book is neither a complete account of histological methods nor a text-book of structural anatomy, but a mixture of both these subjects . . .

Regarding Rutherford's manual

> we cannot but think that it must be nearly impossible to teach in "thirty lessons of from an hour to an hour and a half each", the histology of the various tissues and organs mentioned in the text . . .

The reviewer considered that the book would be of more value to teachers, "by affording hints how best they may arrange the time at their disposal", than to the students themselves.

Rutherford's "Outlines" was compared with Schäfer's *Practical Histology*[257], Foster and Langley's *Practical Physiology*[258], and Harley and Brown's *Histological Demonstrations*[259].

Schäfer's text, written while he was assistant professor at University College, did not, unlike Klein's, seek to describe the tissues, as these, he said, could be found in systematic works. (The order he followed was that found in the 8th edition of *Quain's Anatomy*) The purpose of the work was

> to afford to those engaged in the practical study of Histology, plain and intelligible directions for the suitable preparation of the animal tissues[260].

In this Schäfer was very successful. His directions, for example, for the preparation and examination of the liver, using both injected and uninjected material, sectioned and teased specimens, were a model of clarity.

The review in the "British and Foreign" described Schäfer's text as "an exceedingly valuable work" and "we feel that the thanks of both demonstrators and students of microscopical work are due to him for the conscientious way in which he has fulfilled his task."[261]

Foster and Langley, in their volume regarded histology as one method only of physiological investigation, in which the study of the structure of tissues and organs formed a part of the study of their physiological properties. The review considered it to be suitable only for elementary teaching and

> in the present state of our knowledge it is, we believe, choosing the safer if not the more excellent way to regard the practical study of microscopical anatomy as a skilled labour by means of which facts are to be established without regard to their physiological significance.[262]

This may have been a sound criticism, but the authors, Foster, then at Cambridge, and Langley, his demonstrator, had purposely intended that histology and physiology should be closely combined, and had said that

> Histological work, unless it be salted with the salt either of physiological or of morphological ideas, is apt to degenerate into a learned trifling of the very worst description; and students are generally only too ready to spend far too much of their time in the fascinating drudgery of cutting sections and mounting stained specimens[263].

Foster had clearly stated, though, that the book was intended for elementary classes only, and that he expected his students to know how to use a microscope, to have acquired a knowledge of the fundamental principles of histology and physiology as part of a course of elementary biology,and to have to hand a copy of *Handbook for the Physiological Laboratory*, of which he, Foster, was a co-author[264]. Given these prerequisites, the student was given very adequate and precise directions for carrying out successful investigations of the various tissues and organs. The success of the book can be judged by the fact that it went into a fourth edition in 1882.

Harley and Brown had first published their *Histological Demonstrations* in 1866[265]. A second edition appeared in 1876 and received a scathing review. Harley's statement in the preface to the revised edition, that

> brief though the descriptions of the different modes of investigation are, they are nevertheless found to be adequate to the wants of the ordinary student, by whom it appears that the brevity is regarded as an actual advantage[266]

simply did not acknowledge the demand for detail and accuracy which had centre of the acinus. Sometimes the liver cells contain minute pigment granules.

Each liver cell shows a more or less fibrillated and reticulated protoplasm (Kupfer), and in the centre a spherical nucleus with its reticulum, generally with one or more nucleoli. During activity the liver cells are larger and look more granular than after action.

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The liver cells are joined with one another by an albuminous cement substance, in which are left fine channels; these are the *bile capillaries*, or *intralobular bile vessels* (Fig. 125). In a successfully injected preparation, the liver cells appear separated everywhere from one another by a bile capillary, and *these form for the whole acinus a continuous intercommunicating network* of minute channels. Where the liver cells are in contact with a capillary blood-vessel, there, of course, are no bile capillaries, since these exist *only between liver cells.*

281. At the margin of the acinus the bile capillaries are connected with the lumen of minute tubes; these possess a membrana propria and a lumen lined with a single layer of transparent polyhedral epithelial cells. These are the *small interlobular bile ducts* (Fig. 124). Their epithelial cells are in reality continuous with the liver cells. They join so as to form

Figure 11.
E Klein - *Elements of histology.*
London: Cassell, 1883.
Page 213.

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become necessary in the ten years since the volume was originally published.

On quite a different scale from histological texts published before it, both in format and in number of illustrations, was Klein and Noble Smith's *Atlas of Histology*[267], which was originally published in thirteen parts in 1879 and 1880. The text and preparations were by Klein, then lecturer in Histology at St Bartholomew's Hospital Medical School, and the illustrations by Noble Smith who had been a surgeon at St Mary's Hospital. The work was intended to be a pictorial and literal representation of the structure of the tissues of man and other vertebrates, and it ran to 448 pages of text and included 40 plates, each having from ten to twelve figures. The plates, some of which were coloured, were interleaved into the text. Part X included Klein's description of the structure of the liver, in which he quoted the most recent authorities, including Kölliker, Eberth, Hering and others, and included many of his own original observations.

Each part was reviewed in *The Lancet* as it was published. The review concluded

> With this book and the introduction to Quain's Anatomy by his side, the student or practitioner will learn all that has been recently done and all that he needs to know, unless he is himself making original observations on histology[268].

The same criticism that had been levelled at Klein's section of the "Handbook", could also be made of his "Atlas", namely, that by using actual specimens for illustrations, rather than diagrams, the structure of the tissues and organs was more difficult to understand. It would seem that Klein himself recognised the need for an alternative approach for medical students, when three years later he published *Elements of Histology*[269]. In this he gave a clear, concise account of the structures, with some diagrams, but mostly engravings of figures copied from both the handbook and the atlas. [See fig. 11] The illustrations were integrated into the text. This book was undoubtedly a success, since a second and third edition was published within the year.

The reference to *Quain's Anatomy* in the review of Klein's "Atlas" serves as a reminder that it was not simply in texts of histology or of practical histology that details of the structure of tissues and organs were found.

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Figure 12.
A Thomson et al - *Quain's elements of anatomy.*
London: Longmans Green, 9ed, 1882.
Page 628.

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Probably only the keenest of students, and those with sufficient funds would have afforded a specialist volume, while the majority referred to a copy of a systematic treatise. Indeed, even college and school libraries may not have had copies of all the specialist texts. Theodore Dyke Acland, while a demonstrator at St Thomas's in 1884, noted that

> The histology in Quain's Anatomy is very good . . . while as a text-book Klein and Noble Smith's Atlas is unrivalled. It is unfortunately a very expensive book and there is no copy in our library, but I shall be happy to let those of you who wish to do so look my copy either here or in my house opposite the hospital. For beginners Kirkes' *Physiology* is a good companion for histological work or, for direction on manipulative work, Schäfer's Practical histology is very excellent.[270]

Histology thus appeared in general texts both of anatomy and of physiology. The ninth edition of *Quain's Elements of Anatomy,* edited by Thomson, Schäfer, and Thane[271] was published in 1882. A review in the *Medical Times and Gazette,* having pointed out that the histological section was the work of Schäfer, remarked that

> Being thus brought up to the latest date by editors of the highest distinction in their several departments, the work keeps its old position as the standard English work upon anatomy[272].

In this edition Schäfer still employed Kiernan's diagrams to show gross structure of the liver, but illustrated minute structure with his own informative diagrams. [See fig. 12] Gray's *Anatomy* too remained popular, reaching its tenth edition in 1883[273]. Hughes Bennett in his *Text-book of Physiology, General, Special, and Practical.*[274] included a section on General Histology. Foster, however, in the preface to his *Textbook of Physiology,* noted that "in the presence of Quain's *Anatomy,* there is no need for a physiological treatise to repeat imperfectly what is there said so well"[275]. Yeo, on the other hand, in his *Manual of Physiology, for the use of Junior Students of Medicine*[276], which *The Lancet*[277] in 1884 declared to be the legitimate successor to a similar treatise by Carpenter, included a brief account of histological features of the parts of which he was about to discuss the physiological function.

Microscopes and Microtechnique

New textbooks were published not only to support teaching and learning in a changing curriculum, but also to reflect the better understanding of the structure of tissues and organs. Such understanding was facilitated by the parallel improvement and innovation in microscopy and microtechnique.

The role of microtechnique in the progress of histology in the nineteenth century has been discussed elsewhere by Bracegirdle[278]. A contemporary account of the microtechnique used in a London medical school was given by C H Golding-Bird in his "Laboratory Notes on the working of the Histological Class" in *Guy's Hospital Reports* for 1883. Naturally that described reflects only the opinions and experience of one school:

> I formerly employed here many methods that I have now abandoned, both on account of the time that they demanded in the laboratory, and because I soon learnt that a multitude of methods did not simplify instruction[279]

As early as 1855 The Society of Arts had offered prizes as a means of "promoting the production of a good instrument at a price which should render it more readily accessible to the many"[280]. The prizes, awarded to Messrs Field and Co. of Birmingham, were for a school microscope costing no more than 10s 6d, and for a teacher's and student's microscope costing no more than £3 3s.

Naturally the requirement in 1870 that every student perform for himself microscopical manipulations led to a resurgence of interest and activity in this field. In 1872 both the *Quarterly Journal of Microscopical Science* and *The Monthly Microscopical Journal* contained articles on student microscopes.[281] Payne, a lecturer on morbid anatomy at St Thomas's, in his article in the QJMS, suggested that

> The regulations of the College of Surgeons, now coming into force, which require all medical students to become practically acquainted with histology, and are giving so great an impulse to this study in England, will impose upon many students the necessity of providing themselves with a microscope, and upon many teachers the responsibility of aiding their choice.[282]

He had approached instrument makers for data on their microscopes, and had compiled a table detailing twenty two instruments from sixteen English and Continental makers. He made no recommendations, except that only makers of good repute had been admitted to the list. Ward's article in the MMJ included details of nineteen models from American makers.

Perhaps the best discussion of the suitability of the models available at the time was published in the 5th edition of Carpenter's *The Microscope and its Revelations*[283]. He included a range of student and "educational" microscopes, each illustrated by an engraving. His category of "Third Class Microscopes" he described as those in which simplicity and cheapness were the primary considerations, and which were rather suited for educational purposes than for scientific observation. It was in this group that Field's Educational Microscope, known as the "Society of Arts Microscope" featured, the instrument which, Carpenter said, had won the medal for the best three guinea compound microscope then produced at his suggestion.

The trend for students to acquire their own microscopes was reflected in Lauder Brunton's address at the annual meeting of the British Medical Association in 1891. Looking back over "Twenty five years of Medical Progress", he remarked that "while five-and-twenty years ago comparatively few students possessed a microscope, there is hardly one now who has not got one at his disposal, but is also able to use it"[284].

A new society

One further important means of support at a time of curriculum innovation and change was a forum for practitioners, teachers and others to meet to discuss their work and exchange their experiences. The formation of the Medical Microscopical Society in 1872 satisfied this need.

A circular, reprinted in the *Quarterly Journal of Microscopical Science*, declared that

> As none of the existing Microscopical Societies meet the wants of the student of medicine, it is proposed to establish a new Society, which shall devote itself *solely* to microscopical subjects *in intimate relation with man*, both in health and disease. The objects of the proposed Society will be the Reading and Discussion of Papers; the Exhibition of Specimens,&c.[285]

A notice was sent to the various hospitals and medical journals by J W Groves, Yeo's assistant at King's, informing them of the preliminary meeting, at which it was hoped "qualified medical gentlemen and registered students" interested in the movement would attend.

The secretary of the Quekett Microscopical Club, T C White, suggested that a medical section could, with advantage, be grafted onto either his own club or onto the Royal Microscopical Society[286].

The formation of the new society however went ahead. Golding Bird reported its initial meeting in the *Guy's Hospital Gazette*. At the meeting Groves had justified its existence -

> Though the microscope has now become an almost universal source of amusement and general instruction, yet that Medical Histology is neither worked as it ought to be in this country, nor are there at present suitable facilities for the reading of papers or the exhibition of specimens on medical microscopical subjects . . . The range of subjects proposed to be embraced by the Society, shall include normal as well as pathological histology, as far as it relates directly or indirectly to man . . .[287]

Groves reported that he had received written support from Carpenter, Burdon Sanderson, Beale, Rutherford and others, while supporters at the meeting included Lawson, Payne, Woodman, Hogg, and Lowne[288]. A provisional committee, composed of the honorary secretary of the Royal Microscopical Society, of the Quekett Microscopical Club, and of representatives from each of the London hospitals was elected.

The second meeting was held on December 6th 1872, with Morrant Baker in the chair[289]. Jabez Hogg was elected president. Hogg [1817-1899], whose life spanned the development of the understanding and teaching of histology in England, had been for many years surgeon to the Royal Westminster Ophthalmic Hospital, and honorary secretary to the Royal Microscopical Society from 1867-1872.[290] Hogg was well known for his book *The Microscope: its history, construction, and applications.*[291] first published in 1854 and still in new editions after his death!

Both the *Quarterly Journal of Microscopical Science* and the *Monthly Microscopical Journal* reported the first ordinary meeting of the society on 17th January 1873, and printed in full Hogg's presidential address.[292] It was in his address, which traced the landmarks in the history of histology, that Hogg declared that "the future of histology was secured the moment Bichat gave to the world his admirable work *Anatomie Générale*". He concluded

> May the Medical Microscopical Society fulfil in every way the wishes of its members, and become a pillar of strength in the promotion of "practical histology" among students, young and old, in our profession.

The society was not however long lived. Sharpey-Schafer recorded that

The Medical Microscopical Society . . . had a few years of unobtrusive but useful existence. The formation of the Physiological Society, which included Histology amongst the subjects dealt with, rendered the continuance of a special society unnecessary[293]

That the Physiological Society became the venue for histologists is borne out by the records of the society. At the inaugural scientific meeting Klein showed sections of the submaxillary gland of the guinea pig, and Dr Roy exhibited a microtome for cutting sections of frozen tissue[294]. In 1881, at a meeting at King's College, Klein demonstrated microscopical specimens showing cell structure.

A significant meeting was that held at the physiological laboratory in Cambridge in 1883, at which two presentations point to the direction in which histology was progressing. W H Caldwell, an embryologist, described "the mode of using a new mechanical automatic microtome" and Klein demonstrated microscopical specimens of stained bacilli in blood.[295]

By the 1880s, with the advent of the Conjoint Scheme it became necessary for all prospective practitioners to show proficiency in both theoretical and practical histology. This finally became enshrined in law in the Medical Act 1886, in which the qualifying examination boards, and thus, indirectly, their examinations, were prescribed[296]. The teaching of histology was then supported by a clear syllabus, good inexpensive microscopes, a wide range of textbooks, and, importantly, a growing body of enthusiastic and well qualified men as teachers. By this time, then, histology and microtechnique were fast becoming the servant of many aspects of scientific medicine, the microscope and microtome themselves being the central tools.

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IN RETROSPECT

This thesis has charted the slow and sometimes painful establishment of histology as a universal requirement for intending medical men in the London colleges.

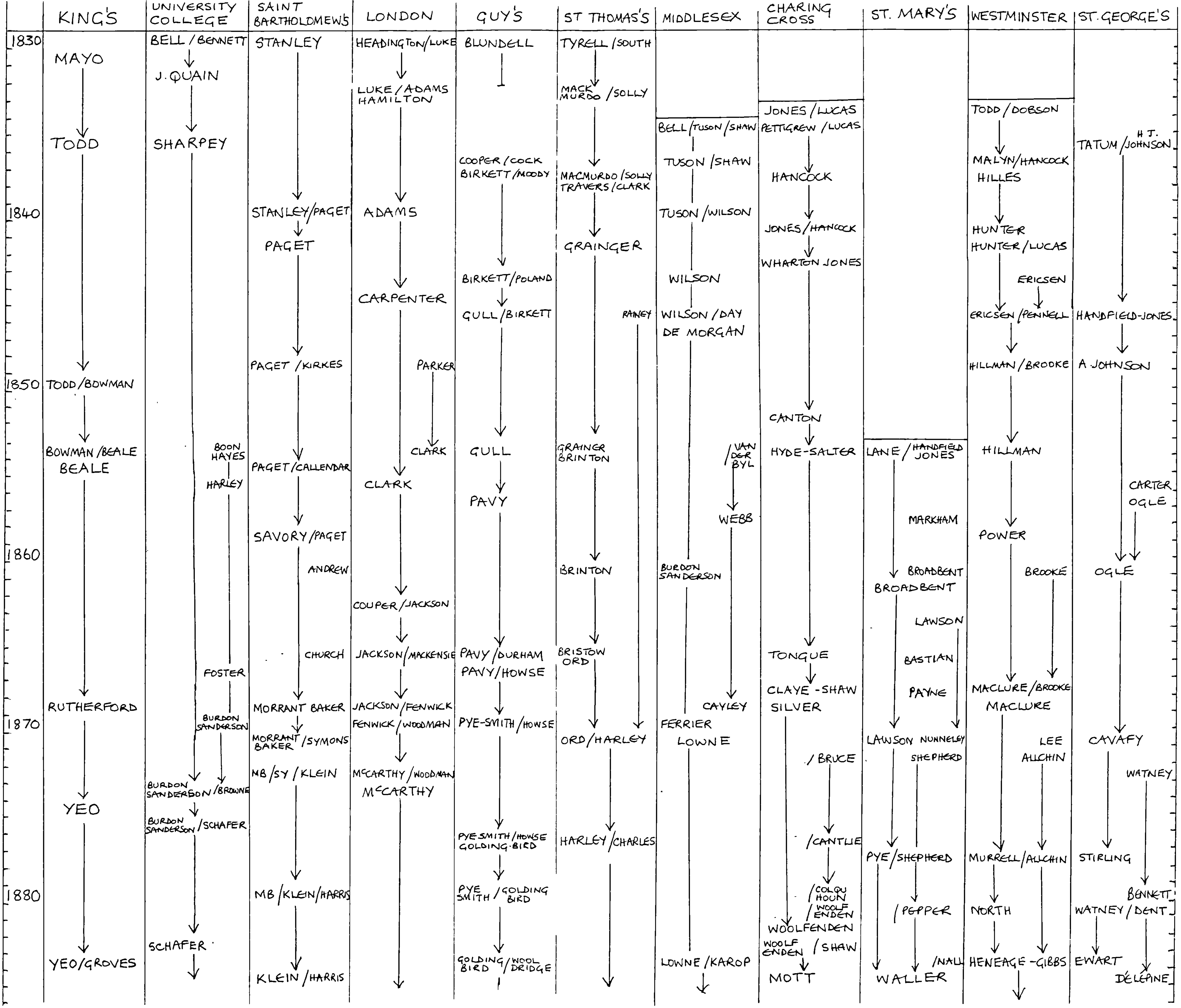
Although Bichat's theoretical framework of tissue classification had been widely accepted during the first quarter of the nineteenth century, it was not until 1827 that the structure of tissues was accurately described for the first time. In the next decade aplanatic objectives of higher and higher power were developed to make the microscope into what was to become the most widely applied scientific tool.

In retrospect it is amazing that a full half century was to elapse before a subject, which seems to us to be so basic for an understanding of medicine, was accepted as such. This thesis has explored in some detail how this came about.

There were two main influences: the changing requirements of the examining bodies, and the development of the practice of medicine itself. There was gradual acceptance of the need to study the minute structure of tissues and appreciation of the benefit of this knowledge in the study of morbid anatomy, diagnosis and therapeutics. The two influences were closely interrelated. Key practitioners were also examiners and the emerging professional scientists were medically qualified and, for the most part, working in medical schools.

A diagram of the teachers of general anatomy or histology in London [See fig. 13] during the period 1830-1886 highlights the large number of men involved, one hundred and forty one in all.

Of these Sharpey stands out for his long period of service at University College. At other schools too men served for long periods, the difference being that Sharpey dedicated his whole time to teaching and examining, while most others also held clinical posts. Indeed, some especially skilled teachers, such as Paget at St Bartholomew's and Bowman at King's College, gave up teaching committments because of the pressures of clinical work and of private


1830
1840
1850
1860
1870
1880
KING'S
MAYO
TODD
TODD / BOWMAN
BOWMAN / BEALE
BEALE
RUTHERFORD
YEO
YEO / GROVES
UNIVERSITY COLLEGE
BELL / BENNETT
J. QUAIN
SHARPEY
BOON HAYES
HARLEY
FOSTER
BURDON SANDERSON
BURDON SANDERSON / BROWNE
BURDON SANDERSON / SCHAFER
SCHAFER
SAINT BARTHOLOMEW'S
STANLEY
STANLEY / PAGET
PAGET
PAGET / KIRKES
PAGET / CALLENDAR
SAVORY / PAGET
ANDREW
CHURCH
MORRANT BAKER
MORRANT BAKER / SYMONS
MB / SY / KLEIN
MB / KLEIN / HARRIS
KLEIN / HARRIS
LONDON
HEADINGTON / LUKE
LUKE / ADAMS HAMILTON
ADAMS
CARPENTER
PARKER
CLARK
CLARK
COUPER / JACKSON
JACKSON / MACKENSIE
JACKSON / FENWICK
FENWICK / WOODMAN
McCARTHY / WOODMAN
McCARTHY
GUY'S
BLUNDELL
COOPER / COCK
BIRKETT / MOODY
BIRKETT / POLAND
GULL / BIRKETT
GULL
PAVY
PAVY / DURHAM
PAVY / HOWSE
PYE-SMITH / HOWSE
PYE SMITH / HOWSE GOLDING-BIRD
PYE SMITH / GOLDING BIRD
GOLDING BIRD / WOOLDRIDGE
ST THOMAS'S
TYRELL / SOUTH
MACKMURDO / SOLLY
MACMURDO / SOLLY TRAVERS / CLARK
GRAINGER
RAINEY
GRAINGER BRINTON
BRINTON
BRISTOW ORD
ORD / HARLEY
HARLEY / CHARLES
MIDDLESEX
BELL / TUSON / SHAW
TUSON / SHAW
TUSON / WILSON
WILSON
WILSON / DAY
DE MORGAN
VAN DER BYL
WEBB
BURDON SANDERSON
CAYLEY
FERRIER
LOWNE
LOWNE / KAROP
CHARING CROSS
JONES / LUCAS
PETTIGREW / LUCAS
HANCOCK
JONES / HANCOCK
WHARTON JONES
CANTON
HYDE-SALTER
TONGUE
CLAYE-SHAW
SILVER
/ BRUCE
/ CANTLIE
/ COLQUHOUN
/ WOOLFENDEN
WOOLFENDEN
WOOLFENDEN / SHAW
MOTT
ST. MARY'S
LANE / HANDFIELD JONES
MARKHAM
BROADBENT
BROADBENT
LAWSON
BASTIAN
PAYNE
LAWSON
NUNNELEY
SHEPHERD
PYE / SHEPHERD
/ PEPPER
/ NALL
WALLER
WESTMINSTER
TODD / DOBSON
MALYN / HANCOCK
HILLES
HUNTER
HUNTER / LUCAS
ERICSEN
ERICSEN / PENNELL
HILLMAN / BROOKE
HILLMAN
POWER
BROOKE
MACLURE / BROOKE
MACLURE
LEE
ALLCHIN
MURRELL / ALLCHIN
NORTH
HENEAGE-GIBBS
ST. GEORGE'S
TATUM / H.J. JOHNSON
HANDFIELD-JONES
A. JOHNSON
CARTER
OGLE
OGLE
CAVAFY
WATNEY
STIRLING
BENNETT
WATNEY / DENT
EWART
DÉLÉPINE

practice.

Prior to 1870 the teachers of histology were usually medical practitioners, and at The London and Guy's, for example, the practice of appointing men to teaching posts only from clinicians in the hospital, meant that the large pool of expertise that existed both in and out of London remained untapped. The pattern of appointment to a teaching post in histology at such schools, initially to a post of demonstrator, followed by that of lecturer for a relatively short period, meant that men grew into the job and enhanced their knowledge and skills in post, only to move on to another sphere. This kind of progression was seen as a step up their professional ladder, rather than the fulfillment of a wish to teach histology. Until the 1870s there was little opportunity for outside stimulus and exchange of ideas and good practice between teachers of histology. After about 1870, as chairs of physiology were established, the teachers were increasingly appointed from professional scientists, who devoted little or no time to the practice of medicine.

At University College and at King's, where lectureships and chairs were widely advertised, men of experience, skill and repute were brought in from outside and remained in post for many years. This did not necessarily mean that they found equipment and accommodation easy to acquire. Only at University College was there a liberal governing body which permitted those it had appointed the flexibility to respond to percieved needs. At schools attached to hospitals such innovations had to be justified as benefitting the patients in the hospital.

A wave of new men appeared in the mid fifties, when competition between the schools was fierce. The ability to offer a course in general anatomy and the use of the microscope would have been a factor, amongst others, in a student's choice of medical school. More importantly, it was seen by teachers and practitioners to be of increasing necessity in the medical curriculum, but one which had to be fully justified to governing bodies in terms of finance and curriculum time.

The aims and organisation of the London hospital schools at this time fostered a utilitarian and correspondingly anatomical approach to physiology. In none of the London schools did the institutional setting lead to a clear separation of physiology from anatomy. The study of "physiological anatomy" could, though, be justified to fundholders in hospitals as worthy of significant expenditure.

A second wave of new blood corresponds clearly with the requirement of the Royal College of Surgeons for the teaching of practical physiology and histology in 1870. Old names were replaced by new, and additional posts were established as the schools tried to meet the new regulations. The practice of appointing only a demonstrator to teach practical histology meant that in schools such as Charing Cross, St Mary's and Westminster, there was a rapid turnover of teachers. Only in a few schools, such as at University College and King's, and to a lesser extent in the old hospital schools, The London, Guy's, St Thomas's, St Bartholomew's and the Middlesex, did a pool of expertise develop.

It was certainly the RCS requirement in 1870 that promoted the teaching of histology. University College, already well placed to meet the changes, went from strength to strength. Others such as King's and St Bartholomew's were able to appoint skilled histologists, and histology flourished under their tuition. Where no such appointments were made schools struggled to meet the requirement.

It was undoubtedly easier to teach practical histology than other aspects of practical physiology, particularly experimental physiology. No problem arose from antivivisectional scruples, and, provided tables, stools and adequate light could be provided, practical work could take place, particularly where accommodation such as dissecting rooms were available in the summer months. In the 1870s and early 1880s, therefore, a large part of the practical physiology was microscope based, and in consequence medical students became proficient in the use of this central tool of scientific medicine.

The availability of microscopes naturally played a part in the establishment of histology in the curriculum. The achromatic/aplanatic microscope was not widely available until the 1850s, and then its cost was prohibitive for students. It was not uncommon for them to have to provide their own instrument, and, until practical work became compulsory poorer students or those less well motivated were disadvantaged in their development of practical skills. On the other hand, a name could be made for original work with a single instrument, with only simple manipulative skills required to provide mounts and patience in making observations.

As the emphasis gradually moved from normal to pathological histology, and from tissue to cell, the same relative easy availability of technique and instrument enabled the motivated student, practitioner, and research worker to develop histological knowledge and skills. What was needed was dedicated space, time and enthusiasm. It was largely the influence of those in positions of authority, such as Sharpey, who could effect this and thus foster the development of histology.

By 1886, though, physiology was becoming established as a separate area of the curriculum, although it still relied on an accurate knowledge of tissue structure.

Microscopical skills and microtechnique developed in parallel. Competence with the instrument became second nature to all medical students, who needed it not only in practical physiology, but in the growing range of scientific medical specialisms.

The availability and cost of textbooks was another factor in the establishment of histology. General anatomy was seen as an aspect of both anatomy and physiology and so appeared in general texts on both major areas of the curriculum. A student would have been most likely to buy a general text such as Quain's *Anatomy* or Todd and Bowman's *Physiological Anatomy and Physiology of Man*, which served as class books at University College and King's College respectively, while for the teacher, treatises such as that of Kölliker contained all the necessary information needed to deliver a course of lectures. The continuous development of knowledge and understanding of the structure and function of the tissues meant that new editions were always in demand. After 1870, though, details of histology were more often found in general textbooks of anatomy.

It has been shown that a large number of practical texts was developed in response to the 1870 regulations. Those to support histology were produced before any comparable texts on other aspects of practical physiology. Indeed, until *Handbook for the Physiology Laboratory* was published in 1873 little was available for the wider physiology class.

The establishment of histology in the medical curriculum on the London medical schools was, then, a gradual process and involved many people. It generated the development of student textbooks and instruments which in turn promoted the courses they supported. It was members of the medical profession who, initially as examiners, first promoted the courses in histology, and then saw them enshrined in law in 1886.

It is significant that in the 1830s and 1840s it was usually the best clinicians who became teachers of histology, and had the major influence on what was taught. By the 1870s and 1880s the best scientists had taken on that role. By then a man could make his name as teacher/scientist, whereas earlier he would have had to leave or curtail his teaching and experimental work if he was to have any career prospects. The fact that at University College, Sharpey, if not a great experimentalist himself, had the vision to encourage the work of young men, meant that after his time a scientifically based physiology department flourished.

By 1886 microtechnique had developed to such an extent that the new regulations could actually be carried out, and practical histology was accepted as a vital part of the medical curriculum. It was to remain so for over a century, until it was displaced to an increasing extent to make way for work based on the genetic code.

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